A SYSTEM OF SYPHILIS

EDITED BY

D'ARCY POWER

AND

J. KEOGH MURPHY

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A
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IN SIX VOLUMES

EDITED BY
D'ARCY POWER, M.B. Oxon., F.R.C.S.
AND
J. KEOGH MURPHY, M.C. Cantab., F.R.C.S.

WITH AN INTRODUCTION
BY
SIR JONATHAN HUTCHINSON, F.R.S.

VOL. IV

SYPHILIS OF THE NERVOUS SYSTEM

BY

F. W. MOTT, M.D., F.R.S., F.R.C.P.

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EDITORS' PREFACE

THE fourth volume of the 'System of Syphilis' differs from those which have preceded it in being the work of a single writer. Dr. Mott has identified himself so completely with many of the advances which have taken place in the Pathology of Syphilis of the Central Nervous System, that the Editors were glad to agree to the wish of the Managers that a whole part should be obtained from his pen. Dr. Mott has thus had an opportunity of discussing the subject in all its bearings, and the present work may be looked upon as the first comprehensive and authoritative statement of the recent advances in our knowledge of Syphilis of the Nervous System in the light of biological and bio-chemical research.

The conclusions are far-reaching, and many obscure parts of a very difficult subject are made plain by the light of the infective theory of syphilis. It is evident, too, that much still remains to be done, and diligent workers in the field of the Pathology of the Nervous System will find by reading this volume in what directions their efforts are most likely to be rewarded by a fruitful crop.

CONTENTS

CHAP. PAGE
I. INTRODUCTION 3
II. GENERAL PATHOLOGY OF SYPHILIS OF THE NERVOUS SYSTEM 20
III. GENERAL SYMPTOMATOLOGY OF BRAIN SYPHILIS . . 55
IV. SYPHILIS OF THE SPINAL CORD 116
V. PARASYPHILIS (FOURNIER); METASYPHILIS (MÖBIUS) . 186
VI. THE CEREBRO-SPINAL FLUID IN RELATION TO SYPHILITIC DISEASE OF THE NERVOUS SYSTEM 200
VII. THE ETIOLOGY OF TABES 216
VIII. GENERAL PARALYSIS OF THE INSANE 255
IX. DIAGNOSIS OF SYPHILIS OF THE CENTRAL NERVOUS SYSTEM 293
X. TABES 319
XI. NERVOUS DISEASE IN CONGENITAL SYPHILIS . . . 416
XII. THE TREATMENT OF SYPHILIS OF THE NERVOUS SYSTEM 458
XIII. GENERAL TREATMENT AND PROGNOSIS OF SYPHILITIC DISEASES OF THE NERVOUS SYSTEM 473

INDEX 485

LIST OF FIGURES APPEARING IN THE TEXT

FIG. PAGE
1. A case of pseudo-general paralysis in a young woman . . . 58
2. The same case at a later stage 59
3. Paralysis of all the external and internal muscles of the left eyeball 68
4. Schematic diagram of the nuclei of the oculo-motor and trochlear nerves 69
5. Diagram of the vascular supply of the crura cerebri and nuclei round the aqueduct 71
6. Photograph of a case showing enophthalmos 75
7. Photomicrograph of gummatous facial nerve 100
8. Symmetrical aneurysms of both carotid arteries 105
9. Multiple aneurysms on the arteries of the circle of Willis . . 106
10. A healed aneurysm of the basilar artery 109
11. Diagram of sensory symptoms in a case of syphilitic cerebro-spinal meningitis 112
12. Section of infiltrated wall of a vessel 114
13. Perivascular infiltration in a case of gummatous cerebro-spinal meningitis 129
14. Gummatous tumour of the corpora quadrigemina 130
15. Gummatous tumour of the cord in the upper cervical region . . 131
15 A. A vessel from the tumour showing perivascular infiltration . . 132
15 B. Part of the same vessel under a still higher magnification . . 133
16. Gummatous pachymeningitis affecting the anterior surface of the cord 134
17. A small vessel showing hyperplasia of the lymph sheath . . . 161
18. Cerebro-spinal fluid of general paralysis and normal cerebro-spinal fluid contrasted to show the Wassermann reaction . . . 207
19. Photographs of a case of conjugal paralysis 227
20. A case of Charcot's joint in the right shoulder 243
21. Two portraits of elated insanity, from Hogarth 256
22. Photograph of a case of grandiose delirium 264
23. Photograph of the upper part of the face of a paralytic with grandiose ideas 265
24. Handwriting from a case of general paralysis 267
25. Temperature chart from a case of rapidly progressing general paralysis 269
26 A. External and upper surface of the brain, showing distribution of veins 278
26 B. Mesial surface of the hemisphere, showing distribution of veins . 279
27. A section through the floor of the fourth ventricle, to show the characteristic ependymal granulations of general paralysis . . . 281

FIG. PAGE
28. (A) Normal Betz cell from the cortex, (B) degenerated Betz cell in general paralysis 285
29 A. Paralysis of the right external rectus in tabo-paralysis . . . 325
29 B. Paralysis of the right internal rectus in early tabes . . . 325
30. Diagram of distribution of posterior roots to the skin (after Seiffer) . 335
31. Diagram illustrating the distribution of cutaneous anaesthesia in the posterior root areas of cases of tabes 338
32. Curve obtained from the previous diagram 339
33. Chart from a case of tabes 341
34. Chart from a case of tabes in the pre-ataxic stage 343
35. Chart from a case of tabes with marked sensory symptoms . . 344
36 A. Chart from a case of tabes 345
36 B. Chart from the same case 346
37., 38., 39. Charts from a case of tabes in the final paralytic stage . . . 347, 348, 349
40. Diagram to show loss of bone sensibility in a case of tabes . . 350
41. Diagram to show somatic and splanchnic nervous structures . . 353
42. Photograph to show hypotonus of the hamstrings in tabes . . . 364
43. The lower end of the femur in a case of Charcot's joint . . . 367
44. Photographs of a tabetic foot 368
45. Photomicrograph of the tibia of a monkey after division of posterior roots 369
46. Photograph showing atrophy of the abdominal muscles in tabes . 372
47. Photomicrograph of section of the spinal cord of a monkey after division of the first sacral nerve on one side 397
48. Section showing degenerated fibres in the cornu-radicular zone . . 401
49–51. Photomicrographs from different cases of tabes, to show the origin and distribution of the endogenous systems of fibres of the posterior columns 404–5
52. A cell of the ciliary ganglion (after Marinesco) 409
53. Diagrammatic representation of the three nervous circles . . 412
54. Juvenile paralytic showing the notched central incisors . . . 421
55. Mouth of congenital syphilitic showing rhagades 441
56. A case of congenital syphilis showing rhagades and Hutchinsonian teeth 449
57. Handwriting from a female juvenile general paralytic . . . 451

LIST OF PLATES

PLATE FACING PAGE

I. Specimens of spirochaetes and trypanosomes 28

II. The characteristic pathological changes in sleeping sickness . 32

III. The characteristic pathological changes in syphilis . . . 32

IV. Gummatous tumour of the falx cerebri. *Colour Plate* . . 36

V. Sections of a gumma of the falx cerebri. *Colour Plate* . . 36

VI. Sections of diseased middle cerebral artery. *Colour Plate* . 44

VII. Sections of diseased middle cerebral artery under a higher power. *Colour Plate* 46

VIII. Section of the middle meningeal artery from a case of syphilitic pachymeningitis. *Colour Plate* 90

IX. Diagram of the localisation of cortical areas. *Colour Plate* . 96

X. Diagram of the arterial supply of the brain. *Colour Plate* . 96

XI. Sagittal section through the cerebrum showing patches of softening 96

XII. Schematic diagram to illustrate the optic tracts. *Colour Plate* 96

XIII. Sections of a gummatous swelling of the facial nerve. *Colour Plate* 100

XIV. Section of part of the cord showing spinal meningitis. *Colour Plate* 114

XV. Sections from the spinal cord of a case of meningo-myelitis with symptoms of Erb's spastic spinal paraplegia. *Colour Plate* . 154

XVI. Further degenerations from the same case. *Colour Plate* . 154

XVII. Photomicrographs showing annular sclerosis of the cord due to obliterative endarteritis 154

XVIII. Sections of the cord from a case of myelitis. *Colour Plate* . 154

XIX. Brain of a fairly advanced case of general paralysis, to show pathological changes. *Colour Plate* 280

XX. Microscopical appearance of the vessels in general paralysis. *Colour Plate* 282

XXI. The appearance of the neuroglia cells in general paralysis. *Colour Plate* 282

XXII. The glia proliferation of general paralysis. *Colour Plate* . 282

XXIII. Sections from the cerebral cortex compared—
- A. Normal.
- B. General paralysis.
- C. Alcoholic polyneuritic psychosis 282

XXIV. Appearances of the ganglion cells of the cortex in general paralysis. *Colour Plate* 286

PLATE FACING PAGE
XXV. Diagram of the cord to show the mode of origin of the afferent exogenous systems in the cord. *Colour Plate* . . . 398
XXVI. Changes in amyotrophic tabes 400
XXVII. Photomicrographs of the spinal cord in tabes . . . 402
XXVIII. Photomicrographs of a case of arm tabes 402
XXIX. Scheme to illustrate the pupil reaction after Bernheimer. *Colour Plate* 410

SYPHILIS OF THE CENTRAL NERVOUS SYSTEM

BY

F. W. MOTT, M.D., F.R.S.

SYPHILIS OF THE CENTRAL NERVOUS SYSTEM

CHAPTER I

INTRODUCTION

The symptoms and signs of syphilitic disease of the nervous system are manifold, but in this work they will be considered under two main headings: syphilis and parasyphilis. The inclusion of the latter may be objected to by some who might assert that there is no absolute proof that tabes and general paralysis are essentially due to syphilis; yet I venture to say that nineteen out of twenty practitioners, when they see a case of tabes or general paralysis, think of syphilis as the cause or probable cause. The causal connexion is now so firmly established in the minds of most men that it would be absurd, in dealing with such an important question as syphilis of the nervous system, not to include these two diseases, for although the majority of cases are not benefited by antisyphilitic treatment, yet from a prophylactic point of view parasyphilitic affections are as important as syphilitic affections of the nervous system. Again, the differential diagnosis of syphilis of the nervous system from parasyphilis is of supreme importance to prognosis and treatment. Especially does this apply to those cases which so closely resemble tabes and general paralysis as to be designated pseudo-tabes and pseudo-paralysis.

Causes of the increase of syphilitic diseases of the nervous system. It is probable that with the conversion of the rural into an urban population, the more ready commingling of the town and country population, short military service and the frequency with which soldiers are syphilized by service in India, and other causes incidental to life in large cities with their armies of prostitutes, syphilis is becoming more widespread. The struggle for existence is falling more and more upon the nervous system, and thus it becomes the *locus minoris resistentiae ;* consequently functional diseases of the nervous system are greatly increased in number, and with the increase of neuroses and psychoses certain combinations of factors leading to degenerative processes are much more likely to occur. The conditions which favour cerebral or spinal neurasthenia combined with syphilis predispose to the parasyphilitic degenerative processes, general paralysis and tabes. In England it is extremely difficult to arrive at any definite statistics relating to the frequency of incidence of disease of the nervous system caused directly or indirectly by syphilis ; still it is considered by all physicians, whether practising as general physicians or nerve specialists, to be the most important cause of organic disease of the nervous system. With the present system of relief at special hospitals, general hospitals, infirmaries, and asylums, a process of selection occurs which interferes with the preparation of reliable statistics regarding the percentage of cases of syphilis which subsequently develop syphilitic or parasyphilitic disease. Statistics have been made abroad, where the conditions are more favourable for obtaining reliable data ; thus Hjelmann found 15–25 cases of disease of the nervous system per 1,000 persons infected with syphilis, excluding general paralysis and tabes. Reumont gives 8·5 per cent. including tabes, and Engelstedt 5 per cent. Erb, whose statistics are based upon twenty-five years' unrivalled experience, considers that 1–3–5 per cent. of persons infected may develop tabes. (For fuller details the reader is referred to p. 218.)

Summary of the evolution of our knowledge of syphilis of the nervous system : It would be impossible to refer to all the published observations, communications to societies, and monographs on syphilis of the nervous system; nor would any useful purpose be served by so doing. At the same time, a sketch of the gradual evolution of our knowledge of syphilis of the nervous system is of interest. Soon after syphilis had spread in Europe, and after the appearance of the first great epidemic at the end of the fifteenth century, isolated observations by several authors indicated that they were aware of the fact that internal organs might be affected by the disease and paralysis result therefrom (Leoncino, 1497). Also later authors, Van Hutten and Paracelsus, referred to the affection of internal organs, although syphilis could not be attributed as the sole cause. The former, indeed, stated that sometimes syphilitic persons were affected with paralysis. Fallopio and Botallo described diseases of bone in the neighbourhood of the nervous system, caries or necrosis, tophi or gummata. The first definite reference to syphilitic brain disease I am aware of is given by Morgagni, when he states that gummata are not always found in the periosteum and bones. ‘Qui in Theatro hoc nostro tria gummata candida, recluso cranio, ostendi vidit et Antonio Molinetto quae inhaerebant durae membranae, verum etiam ex Guarinonio scribente, *se vidisse gummata dicta in cerebro concreta.* Quam potissimum sedem memoro, quia haec adscribuntur ad eiusdem observationem in qua *tria corpuscula tanquam gummata virentia* in viri cerebro conspecta leguntur, qui ex lue de qua loquimur epilepsiae et convulsionibus obnoxius, denique gravissimo sopore confectus est’ (*Epistola Anat. Med.* lviii, Art. 9). Moreover, Morgagni in his *Epistola Anat. Med.* xxvii, Art. 28, describes not only aneurysms as occurring in syphilitic persons, but also disease of the smaller vessels of the brain, which he observed in making a post mortem on a syphilitic man; thus he states: ‘Sed in tenui meninge arteriarum trunci omnes, omnesque item earum rami, iique presertim qui plexum choroidem versus contendunt, multo erant crassiores aequo, et duriores; exsiccatique osseam pluribus in locis naturam ostenderunt.’ This condition may, however, have been arterio-sclerosis. In the year 1740 Astruc, in his book *De Morbis Venereis*, speaks several times of syphilitic lesions affecting the functions of the nervous system. It thus became recognized that syphilis could affect the internal organs, including the nervous system. Then a set-back to our knowledge occurred, for John Hunter, about 1790, taught that the internal organs were not affected by syphilis; moreover he said: ‘We have not seen the brain affected, although such cases are described in authors.’ The weight of his great authority seems to have inhibited further reference to syphilis of the nervous system until, in 1834, Lallemand presented a collection of syphilitic brain and nervous affections; moreover, Dittrich showed that the liver was liable to be affected, and soon it became widely recognized that none of the internal organs, including the brain, are spared in syphilis. Then Virchow's teaching of the morbid histology of syphilitic gummatous lesions placed our knowledge of the disease upon a surer basis, with the result that numerous observers abroad and in our own country published observations and monographs on syphilis of the nervous system. Some of the more important contributions were made by Leon Gros, Lagneau, Lancereaux, Zambaco, Griesinger, Budd, Passavant, Steenberg, Wagner, Wilks, Hughlings Jackson, Mickle, and Bristowe. Clifford Allbutt in 1870, first described the microscopic characters of syphilitic disease of the arteries, but it was Heubner who four years later, published a classical monograph upon syphilitic disease of the cerebral arteries. This was by far the most important and practical addition to our knowledge of syphilis of the nervous system since Virchow's description of the pathological anatomy of syphilitic gummatous lesions. It was then shown by a number of authorities that not only acquired but hereditary syphilis affects the central nervous system, producing the same pathological changes, neoplastic formations, arterial disease and degenerations. The names of Virchow, Fournier, Charcot, Barlow, Bury, Ljungren, and Von Zeissl are associated especially with this advance in our knowledge of syphilis of the nervous system. Still another chapter had to be written, I refer to the system degenerations, the primary decay of the neural elements, a late result of the syphilitic infection. Parasyphilitic or metasyphilitic affections, as they are called. The full history of this will be given later, but it will not be out of place to mention the fact that Alfred Fournier was the first to express the view that locomotor ataxy is a post-syphilitic disease, and Erb has done more than any one else to support this doctrine of Fournier, by his remarkable collected statistics extending over a period of twenty-five years, embracing 1,100 cases of tabes and 10,000 non-tabetic patients as a control. Esmarck and Jessen, and later, Kjelberg, were the first to call attention to the fact that general paralysis occurred especially in persons who had suffered with syphilis, but it was Fournier who really put forward the doctrine that general paralysis was, like tabes dorsalis, a consequence of syphilis, and that the two diseases were so similar in their etiology that they might probably be regarded as one disease affecting different parts of the nervous system. Krafft-Ebing by his observations, did more than any one else to substantiate the syphilitic doctrine of Fournier, and he put forward the dictum now widely accepted: 'General paralysis is a product of syphilization and civilization.'

Within the last fifteen years four most important works have appeared dealing with syphilis of the nervous system, I refer to those of Fournier (on Parasyphilis), Lang, Oppenheim, and Max Nonne, and I wish here to state that I have obtained from these works much valuable information.

Proof of syphilitic infection and its difficulties. According to my experience, in a considerable number of cases no history of syphilis can be obtained, nor can any syphilitic residua be found on the body in persons suffering with syphilitic or parasyphilitic disease of the nervous system. Sometimes the patient wilfully conceals the fact, but very often he is unaware that he has been infected. Upon inquiry it will be often found that the patient has had a slight sore or pimple, which did not cause him any trouble, or he has had a urethral discharge, which he thought was due to a mild form of gonorrhoea, but which really was a chancrous urethritis. It is particularly difficult to prove syphilitic infection in women. I found in the study of hereditary syphilis and juvenile general paralysis, that children were born with the most marked signs of syphilis on the body, and yet the mothers have said that they never ailed nor could I find any objective signs of syphilis on the body. Vide cases on p. 8. But it must be remembered that neither age, sex, nor social position necessarily excludes the possibility of infection, and if in the absence of history or signs of syphilis, a patient comes with symptoms pointing to disease of the nervous system, which may be of syphilitic origin, one is justified in treating it as such upon the supposition that it might be syphilitic ; and not infrequently the experiment meets with the most marked success. Fournier speaks of the frequency of *syphilis insontium* and remarks that in about 50 per cent. of his female syphilitic patients he was unable to obtain any history of infection.

Crocker found that he was unable to prove a history of syphilis in 20 per cent. of his cases suffering with syphilitic skin lesions. Hirschl, among 63 cases of syphilis in a late form, occurring in the department of Lang in Vienna, only found a certain history in 54 per cent., in 9·5 per cent. it was probable, in 36·5 per cent. in spite of the existing syphilitic disease, evidence of infection was not forthcoming. No doubt some cases where no history of infection can be obtained may be due to late manifestations of congenital syphilis. This applies particularly to some cases of tabes and paresis occurring in early adolescence. Vide pp. 231–34. Again, some cases arise from extra-genital infection. The percentage of these cases is not known in this country, but according to Hahn it occurs in 4·5 to 5·5 per cent. in France, Germany, and Denmark, a much higher percentage, I am convinced, than occurs in Great Britain. According to the statistics of Von Beloussow, in Russia only 26 per cent. were infected in the genital organs. Consequently there must be a great number of children who acquire syphilis.

In quite a number of cases of syphilitic disease of the nervous system no history may be obtainable, and yet at the post mortem or during life positive evidence of syphilitic lesions are found. The genital organs will sometimes show the scar of a chancre, the lymphatic glands are enlarged or shotty, there are papery scars, a palmar psoriasis, a glossitis or syphilitic orchitis.

A patient, aged 17 years, was sent to the hospital to see me, suffering with epileptiform fits ; I ascertained from a relative that he had been infected with syphilis by sleeping with a syphilitic shop-assistant. He improved markedly on iodide of potassium.

A patient, aged 27 years, was sent to me suffering with severe pain in the region of the gall bladder. He denied syphilitic infection entirely and I could find no signs on the body. An exploratory operation was performed and a gumma of the liver close to the gall bladder was found. Eight years later I saw him again. He had had a blow on the supra-orbital ridge causing a gumma. This disappeared completely with mercurial inunction and large doses of iodide.

A number of cases of syphilis of the nervous system have come under my notice that have either got well or improved with treatment, yet no history or evidence of syphilis was obtainable.

It is necessary, however, to point out that not every scar or patch of pigment on the skin is a proof of syphilis; at the same time, careful search will often reveal residua which might easily have been overlooked. It was pointed out by Gowers that the Argyll-Robertson pupil is an almost certain sign of syphilis, Joffroy and Schramek have shown also that a pupil with an irregular contour (if congenital anomalies can be excluded) is a sign of syphilis or parasyphilis. Of course it may be due to synechiae, but then these are usually syphilitic. If I find either of these pupil phenomena, especially the former, I regard syphilis as almost proved, and I ask the patient: When did you have venereal disease? Often such a direct question will prevent prevarication.

It is often presumed that a so-called soft sore is not syphilis. Many of these soft sores are chancroids, and are the primary sore of syphilis, but they are sometimes only treated by local applications and serious consequences ensue.

A young man was sent to me complaining of headache, internal strabismus, and double vision; he had also commencing optic neuritis. I ascertained that ten weeks previously he had contracted a so-called soft sore, which had been treated only locally with iodoform. I put him on mercurial inunction and the symptoms rapidly left him. Moreover, it is thought that if a patient has had a bubo, he cannot, therefore, have suffered with syphilis; this is an error, for I have seen serious nervous symptoms (which were relieved by mercurial treatment) follow. Doubtful cases should be examined microscopically for the *Spirochaete pallida*; moreover, the bio-chemical examination of the blood and cerebro-spinal fluid by the Wassermann method would enable a positive diagnosis of syphilis to be made. The question whether mild or severe forms of syphilitic infection are more liable to be followed by severe diseases of the nervous system is one of considerable importance, and has been discussed by many authorities. The late Sir William Broadbent was one of the first to call attention to the fact that severe symptoms often follow mild attacks of syphilis. Gilbert and Lion consider that spinal syphilis in opposition to brain syphilis, comes after severe symptoms of the disease. Hjellmann came to the conclusion that severe forms of brain syphilis arise from mild and moderately severe forms of the affection. My experience seems to show that severe nervous affections may follow all forms of syphilis whether mild or severe. It is possible that the mild forms are treated inadequately, or not treated at all; it certainly is a fact that the parasyphilitic affections are more often found to occur in individuals who have had a mild attack; the symptoms having been in some cases so slight as to have been neglected or overlooked (vide p. 248 for explanation). Fournier and most of the leading authorities hold the opinion that syphilitic disease of the nervous system is much less likely to occur when the disease has been efficiently treated with mercury. Some authorities hold that over-treatment with mercury may lead to systemic degenerative affections of the nervous system. I have recently seen a case which might be thus interpreted.

CASE 1. A man, aged 30 years, contracted syphilis in 1903. He had sore throat and rash and was treated almost continuously with mercury for three years, with occasional remissions of the treatment. He came to me suffering with weakness of the legs, stiffness, exaggerated knee-jerks, ankle clonus, Babinski's sign, cystitis and frequent micturition, no definite anaesthesia except a possible patch on the buttock, a slight feeling of tightness around the upper part of the abdomen with absence of abdominal reflexes. The urine was alkaline and contained streptococci. He had been vigorously inuncted but had been getting worse rapidly. I took him off the mercury and administered iodide, had the bladder washed out, gave urotropine and boro-citrate of magnesia, and sent him to the country. Under this treatment he rapidly improved and soon was able to walk miles. Beyond slight signs of pyramidal tract degeneration he appears now to be quite well. This was a case of slight focal meningo-myelitis, in which the mercury had done all the good that it could do, and its continuance had led to positive harm.

Causes which act as co-efficients in the production of lesions. Any cause which lowers the vitality of the tissues may set up the syphilitic neoplasia, and it may be asked, are the specific organisms in such a case lying in the lymph clefts, in a dormant resting stage, or have the fixed tissue cells been so modified in their activities by the virus that injury or other causes may lead to their formative hyperplasia ? Injuries to the head have long been recognized as a cause of organic syphilitic brain disease, and I may add also of general paralysis. We can understand how a blow on the head will produce a localised gummatous meningitis, vide case 11, p. 82, which may remain local or be the starting-point of an extending disease ; for a kick on the shin will produce a gummatous node. Cerebral commotion and concussion may cause a traumatic neurasthenia, and we know that the subjects of such an affection manifest a *locus minoris resistentiae* in their brains ; for small quantities of alcohol which they could have taken prior to the injury without harm, now act as a poison causing mental symptoms. We can, therefore, understand why a man who has suffered with syphilis and receives a head injury causing a *traumatic neurasthenia* stands a chance of developing general paralysis. Likewise, but much more rarely, are found cases of syphilitic gummatous meningo-myelitis which follow trauma. The following case occurred in my practice.

CASE 2. A soldier, aged 28, contracted syphilis ; eighteen months later, he was thrown from his horse and he felt considerable pain in the back, but was able to walk after the accident, and he observed no symptoms for a week ; then he felt a tightness in the lower part of the abdomen, weakness in the legs, and difficulty with his bowels and bladder. He had been previously treated with mercury from the commencement of the chancre, I saw him eighteen months after the onset of the spinal symptoms ; he had spastic gait, ankle clonus, Babinski's sign, difficulty with the bladder and bowels, abdominal and cremasteric reflexes absent, no loss of sensation.

Of all the causes which predispose to syphilitic brain disease probably *alcoholic excess* is the most important (vide case 3, p. 35), but excesses of any kind, especially in *baccho et venere* or *mental stress and worry* tend to develop diseases of the nervous system ; *lead poisoning* may be a factor, and it is often a matter of speculation how far the symptoms are due to the lead or the syphilis. Tarnowski's statistics of 100 cases of cerebral syphilis are of importance in showing that co-efficient factors increase the danger of a syphilitic person suffering with brain disease ; for 43 were chronic alcoholics, 29 were neurasthenics : in 6 there was a history of mental stress, and in 5, head injury. In only 17, therefore, was there not a co-efficient. Even more important than the above-mentioned co-efficients is the absence of early, prolonged and effectual treatment with mercury. Fournier lays especial stress on this as a cause. Certain individuals are more prone to affection of the nervous system than others, owing to an *inherited neuropathic tendency.*

The specific virus may have a *special neurotoxic influence.* Vide Chapter VI, ‘Etiology of Tabes,’ p. 246. Gilles de la Tourette and others have recorded a series of cases of nervous disease following infection from the same woman.

It is considered by some authorities that chancre of the finger and lip are more liable to be followed by a serious nervous disease than when the primary sore is on the genital organs ; it is possible that this may be due to the fact that fewer lymphatic glands intervene between the primary sore and the lymphatics of the central nervous system. Oppenheim throws doubt upon extra-genital chancre being more liable to be followed by syphilis of the nervous system.

There may be an inherent tendency for the nervous system in some individuals to be affected. I had under my care two brothers, who were infected with syphilis about the same time, while in the army, and both were in the hospital fifteen years later suffering with gummatous affection of the brain ; both made a partial recovery after treatment : vide Cases 12 and 13, p. 82.

Period of Onset of Nervous Symptoms. It was formerly taught that syphilitic nervous diseases occurred in the later tertiary periods. Fournier himself stated in his first edition that syphilitic nervous disease seldom occurs in the first or second year after infection. Heubner stated that almost without exception a year elapsed before nervous affections occurred; generally more than three years elapse. One of the first authorities to doubt this view was Rumpf, who collected statistics of 13 cases; Charles Mauriac also made the important observation that cerebro-spinal syphilis occurred most frequently in the first year. Lang refers to a collection of 100 cases of cerebral syphilis made by Braus in 1892, in which the history of infection was obtainable, and nearly one-half of which occurred within the first year. Naunyn analysed 45 of his own cases and 290 collected cases, and he came to the conclusion that syphilitic diseases of the nervous system appear more frequently in the first year after infection, and that their frequency diminishes from year to year. Again, Beaudoin collected 26 cases in Fournier's clinic in which nervous symptoms occurred within three to six months after infection. Many of the older writers, Leon Gros, Lancereaux, Zambaco, Ljungren, and others, have described cases of early syphilitic disease of the nervous system, and Kahler described a case which occurred while the primary sore was yet unhealed. I myself have seen definite signs of basic meningitis occur within ten weeks of infection, vide p. 9. A patient of Nonne's was affected within three months of infection, and a case has been described by Gilles de la Tourette and Hudelo that occurred within four weeks of infection. In the light of our present knowledge obtained by experimental observations on apes this is not surprising. Lang has pointed out that often during the outbreak of the syphilitic exanthem, headache, giddiness, pyrexia, increased frequency of the pulse rate or slowness of the same and irregularity of the pupils sometimes occur, due to an affection of the meninges.

In 40 cases of cerebral syphilis which came under my observation, in which a history of syphilis and the time which elapsed between the onset of the cerebral symptoms and the existence of the primary sore were determined, it was found that 5 occurred in the first year, 7 in the second year, 6 in the third year, and 3 in the fourth year. These were mostly hospital cases, for, as a rule, the notes of asylum cases, especially the severe fatal cases often diagnosed as general paralysis, do not, owing to their demented condition, afford the necessary information, and the friends are seldom able to help in this matter ; occasionally the notes supplied from a hospital, where the patient was formerly treated, gave the required information.

As regards spinal syphilis, Gilbert and Lion have shown with Fournier that, *syphilis medullaire précoce*, as they term it, occurs most frequently within the first two years of infection. In 16 out of 47 cases the disease commenced within three to six months after infection; the maximum number of cases occurred within the second quarter. Hutchinson has seen an acute paraplegia develop within six months to three years of infection in 15 cases. Vide also pp. 119, 120.

In connexion with some of the foregoing statistics it must be remembered that there is a tendency to fallacy in evidence adduced from collected statistics ; viz. that early and severe cases would be looked upon as cases of interest, and more likely, therefore, to be observed and published.

Ultimate Results of Brain Syphilis. It is said that one-fourth of the cases of brain syphilis recover, another fourth decidedly improve, at least one-half die or only partially recover and remain mentally or physically incapacitated.

It is of special importance to emphasize the fact *that cerebral syphilis seldom strikes without warning symptoms* ; often the warning is neglected not only by the patient, but also by the medical man, especially when the disease affects parts of the brain which are functionally related to the higher mental processes of association ; in these cases the symptoms are mental. It is fortunate that ocular paralysis is so frequent, for, whereas a headache may be neglected by the patient, a squint or ptosis interferes with his occupation and brings him at once to the hospital.

I. *Syphilitic Diseases of the Nervous System.* (*a*) Syphilitic diseases of the brain may be considered under the following headings :—basic meningitis, meningitis of the convexity, cerebrospinal meningitis, arteritis, and lastly, gummatous tumours.

My experience indicated by recorded cases in which autopsies were performed, shows that all these conditions may be more or less combined in the severe and early forms of the disease.

(*b*) Syphilitic diseases of the spinal cord.

II. *Parasyphilitic Affections.*

(*a*) Tabes dorsalis.

(*b*) Tabes optica.

(*c*) Dementia paralytica.

According to some authorities, Bosc,Lesser, Hirschl, Nageotte, and others, general paralysis and tabes are quaternary syphilis ; the former authority asserts, and with some degree of correctness, that there is a general similarity even in the lesions of general paralysis and tabes to other syphilitic lesions : viz. there is an endothelial and conjunctival hyperplasia with a tendency to fibrous and sclerous formation. But there is more than this, there is a primary neuronic decay which we cannot account for solely by the changes in the supporting and enclosing nutrient tissues the same as we can in syphilitic lesions.

Tabes and general paralysis are therefore spoken of by Fournier as parasyphilis, and by Möbius as metasyphilis, implying thereby that although syphilis is the essential cause, the disease is not directly due to the syphilitic virus. If we regard these affections as primary decay of the neurones caused by the syphilitic poison we are correct in assuming that general paralysis, optic tabes, and spinal tabes are one disease. My observations on the etiology and pathology of these diseases (vide p. 221) strongly support this contention, and Dr. Ferrier in his valuable Lumleian Lectures takes a similar view. The consensus of opinion now is in favour of tabes (used in the above wide sense) being a post-syphilitic manifestation. One of the strongest arguments in favour of this view is the fact that the Argyll-Robertson pupil is only met with in tabes and syphilized individuals. Babinski states that a person who has this pupil phenomenon and no other sign or symptom is syphilitic, and is a candidate for general paralysis or tabes. Yet if we look for syphilitic residua on the body in cases of tabes or general paralysis we do not find them nearly so often or so readily as in syphilitic disease of the nervous system, vide p. 234. In males, scars of chancre or other syphilitic residua may be found post mortem in 40–50 per cent.; in women, however, not more than 25 per cent. show definite objective signs apart from the pupillary phenomena. I may say, however, that 50 per cent. of the female general paralytics show non-tubercular old adhesive inflammation of the Fallopian tubes, which probably always means venereal infection. Many authorities refuse to accept Krafft-Ebing's dictum of syphilization and civilization as the cause of general paralysis and tabes, and point to statistics of cases in which a large proportion exhibited no signs of syphilis, nor could a history of infection be obtained, but Hirschl and Crocker's observations (vide p. 8) should be taken into consideration.

Although general paralytics and tabetics in the early stage of disease are very prone to have promiscuous intercourse, yet, to my recollection, I have never seen in a large experience a recent infection or secondary eruption. The shortest time I remember between infection and the onset of general paralysis is three years. This occurred in a prostitute who had signs of congenital syphilis; admitted to the asylum, aged 27, with a history of a chancre three years previously.

This conforms with the observation of Krafft-Ebing who inoculated with the virus of a hard chancre nine general paralytics, in whom there was no evidence of syphilis, and watched them for one hundred and eighty days or more without seeing any syphilitic manifestations; presumably therefore these subjects were immune by reason of inherited or acquired infection. Immunity may be inherited or acquired and depends upon the production of antibodies which will neutralize the effects of the toxin. It has already been stated that general paralytics and tabetics have less often syphilitic residua, and this is due to the fact that the primary sore and the secondary and tertiary manifestations are frequently mild and comparatively slight. Often the chancre is looked upon as a soft sore, and Hitzig, Buzzard, and others have thought there may be several poisons to explain the well-acknowledged fact that the symptoms and signs of acquired syphilis are mild in persons who subsequently develop tabes. Hitzig compared this experience with diphtheria, remarking that it was the mild cases that subsequently developed diphtheritic paralysis. Other authorities have argued that it is these mild cases which are not treated with mercury, and therefore the syphilitic virus produces more damaging effects upon the neurones. Again, other authorities have asserted that over-treatment with mercury is the cause of the decay of the nervous structures. There is some evidence to show that the virus may be attenuated and altered by racial syphilization and mercurial treatment, and thereby account for these late manifestations of syphilis. I shall later cite a few illustrations in favour of this view; moreover it is conceivable that the spirochaete may become attenuated in its virulence, or even acquire a special neuro-toxic action (vide cases, p. 246).

Then there is the stress theory of Edinger. The whole nervous system suffers from the poison, but the part which will suffer most is that which is most used and subjected to stress. It is a remarkable fact pointed out by Benedikt that persons suffering with optic tabes usually remain for many years in the preataxic stage. It is possible that the loss of vision removes so much of the stimulus to activity and using up of nerve potential that, provided there is not constant worry, neuronic decay may be arrested, and the patient therefore remains in the pre-ataxic stage. However, I have seen not a few cases which were blind from optic atrophy develop tabo-paralysis; often in these cases there was a history of worry from loss of occupation and breaking up of the home, leaving the family destitute (vide p. 328). The nerve cells are perpetual elements incapable of regeneration and depend for their durability upon an inherent potential energy calculated to outlast the other tissues of the body in the normal healthy individual. In certain acquired or congenital syphilitic individuals the durability of the neurones is greatly curtailed, so that they die prematurely and give rise to a series of symptoms which may be associated either with irritation of definite nerve structures, e. g. lightning pains, visceral crises, and epileptiform convulsions, or with neural destruction, e. g. ataxy, paraesthesia, anaesthesia, paresis, and dementia. The irritation phenomena may be the signs of increased neural irritability prior to their death and loss of function. Now we may ask what evidence is there to show how this neural irritation and destruction are brought about. It may be asserted (1) that it is quaternary syphilis, and the changes in the membranes, vessels, and connective tissue structures (neuroglia) are primary inflammations causing secondary irritation and destruction of the neural elements. If we admit this premise, then it must be assumed that the *Spirochaete pallida* or the living virus has passed into a resting stage, and after a lapse of years, on an average ten, it has become active; but this has so far not been demonstrated.

(2) That it is parasyphilis. A premature decay of the neural structures owing to a lack of durability, caused by the action of the poison, combined with stress, on the most differentiated and complex cells of the body, cells which are perpetual and incapable of regeneration.

(3) That it is the result of the ancestral acquired immunity to syphilis from widespread racial syphilization, so that the individual, when he is infected, takes the disease in a mild form and presents only slight symptoms. This immunity is due to the neutralization of the syphilitic poison by the rapid production of antibodies, and, in the case of the nerve cells which are perpetual elements, the production of these antibodies continues during life and leads to exhaustion of those systems and communities of neurones which are subject to functional stress. The psychasthenic, would thus tend to develop paralytica dementia and the spinal neurasthenic, tabes dorsalis. It must be confessed that there are unsatisfactory features about all these explanations. Possibly in the last named the fact that Wassermann, Neisser, Brück, Plaut, Morgenroth and Stertz, Marie, Levaditi, and others have demonstrated the presence of syphilitic antibodies in the cerebro-spinal fluid of cases of general paralysis and tabes lends support to this theory (vide chapter Cerebro-spinal Fluid, p. 200).

(4) That the specific virus in certain cases produces a special neuro-toxin. If we believe the spirochaete is the cause, we should in such case have to assume that the spirochaete is either different or has become modified. We do know that the *Trypano-*

soma Gambiense and the *Trypanosoma Equiperdum* have a special affinity for attacking the lymphatic structures of the central nervous system, giving rise to lesions closely resembling in many respects syphilitic and parasyphilitic affections ; but, as pointed out, p. 246, there is only a little definite evidence in support of this theory.

Lastly may be mentioned Ford Robertson's *Bacillus paralyticans*, a diphtheroid organism which he claims to be the cause of general paralysis and tabes, but he assumes that syphilis, alcoholism, &c., prepare the way for it. This view, however, has obtained very little support or confirmation. It is probable that diphtheroid organisms in conjunction with many other organisms more toxic in their action, e. g. pneumococci, staphylococci, and streptococci, hasten the fatal termination by secondary or terminal infection. Candler has made a most careful investigation on these lines, and he concludes that diphtheroids do not play an important part even in secondary or terminal infection. Marie comes to the same conclusion. Both observers conclude that there is no proof of a *Bacillus paralyticans*.

CHAPTER II

GENERAL PATHOLOGY OF SYPHILIS OF THE NERVOUS SYSTEM

In considering the general pathology of syphilis of the nervous system it is not necessary to refer to the different bacterial and other organisms which have been described by various authorities as being the specific agent in the production of the lesions characteristic of this disease before the discovery of the *Spirochaete pallida* by Schaudinn. This organism, whether it be, as its discoverer believed, a protozoon or a bacterium or micro-organism between a protozoon and a bacterium, is regarded as the specific organism of syphilis by those best competent to judge, viz. Metchnikoff, Hoffmann, Neisser, Levaditi, Bertarelli, and many others. Metchnikoff and Roux were the first to demonstrate experimentally the communicability of syphilis to animals, and to show that the nearer the animal approached to man the more the disease approached in its characters and virulence the human form of the malady. Thus, although other animals, especially apes and anthropoid apes, have been successfully inoculated, the chimpanzee alone reproduces with absolute certainty the human symptomatology. This is as we should expect, for the blood precipitive reaction of this anthropoid approaches most nearly that of man. The experiments of Neisser, Hoffmann, Bertarelli, Levaditi, and numbers of others have confirmed this important discovery, and many new facts have been added to our knowledge of the general pathology of syphilis by experiments on apes and other animals; I would mention in particular the important discovery by Bertarelli, that he was able to inoculate the spirochaete into the cornea of the rabbit and transmit it through a series of such animals. Levaditi has experimented with the cornea from one of these animals, and not only transmitted from it the disease through a series of rabbits, but used the cornea infected with spirochaetes to produce a true syphilitic lesion in the eyelid of an anthropoid ape. Lastly may be mentioned the important observations upon the biochemical changes in the fluids of the body by the Wassermann, Neisser, and Brück methods of serum diagnosis. Upon this tripod, of the discovery of the specific spirochaete, the communication of the disease to apes and the serum diagnosis, a vast amount of most valuable work rests, the tripod is mutually supporting, and every day fresh evidence is forthcoming to strengthen the opinion that the true cause of syphilis has been discovered; that, although as yet no vaccine has been successful, this is no longer a hopeless outlook; and, lastly, that a most valuable means of diagnosis of syphilis and parasyphilis has been obtained.

I refer the reader for full information regarding the microbiology of syphilis to the section on that particular subject in the first volume of this System by the master hand of Metchnikoff (vol. I, pp. 41–102). Still it will help the reader to understand the general pathology of syphilis of the nervous system if some of the more salient facts are here described.

Schaudinn and Hoffmann were able to prove that the *Spirochaete pallida* is found in all cases of syphilis and is never found in any other affections. They also discovered spirochaetes in fresh preparations, not only on the surface of the chancres and papules, whether of the skin or mucous membranes, but also in the depths of the tissues and in the juice of enlarged inguinal glands of syphilitic cases. Metchnikoff, Roux, and Levaditi have demonstrated the presence of the spirochaetes in chancres on the face and penis of monkeys in association with other organisms; they also found the spirochaetes in papules. Buschke and Fischer discovered spirochaetes in abundance in the liver and spleen of an infant affected with congenital syphilis, and Levaditi demonstrated numbers of spirochaetes in the fluid contained in the bullae of pemphigus occurring in a congenital syphilitic infant. Since then an ever-increasing army of workers have, with a few notable exceptions (Saling, Schulze), supported the discovery of Schaudinn. In fact, this organism has been shown in every possible lesion which is definitely syphilitic (vide Plate I, Figs. 1, 2, 3, 4, and 7). In some cases they cannot be found in the primary sore unless a very careful search is made, and even then the search may not be successful. The same applies, with even more force, to the secondary eruptions.

The spirochaetes have been discovered in the capillaries of the skin and in the perivascular tissue. Although only occasionally found in the blood, the spirochaetes are more numerous in the lymph and lymphatic organs in general, and, according to Metchnikoff, their presence in lymphatic vessels may be said to be constant in syphilis, and it is at times possible to see a very large number in the perivascular spaces, although their number in the corresponding blood-vessels may be exceedingly limited. I have examined a number of primary sores, mucous tubercles, and cutaneous papules sent to me from the Lock Hospital, and in all cases smears have shown spirochaetes by the Giemsa method, sometimes, however, only after long and diligent research. In one case of secondary papules I found the spirochaetes by Levaditi's method although I was unable to find them in the blood (vide Plate I, Fig. 7). When the disease becomes generalized and there is a polyadenitis the organism can be found in glands far removed from the primary lesions; thus Lewandowsky found spirochaetes in the juice of the epitrochlear gland. It is presumed that for a short time, perhaps some hours, the organisms remain in the lymph clefts and spaces of the tissues at the point of inoculation, there they multiply, and in a short time extend into the lymphatics and produce microscopic changes, although macroscopic changes are not visible. In confirmation of this it may be mentioned that Levaditi and Yamanouchi have inoculated the chimpanzee with syphilis, and at a time when the point inoculated did not show the slightest macroscopic indication of primary syphiloma they were able to detect, by the aid of the microscope, an active multiplication of spirochaetes and specific histological changes. Levaditi and Yamanouchi have recently published some very interesting researches upon incubation in syphilis. These observers made a series of observations on keratitis in the rabbit induced by introducing a small portion of an infected cornea into the anterior chamber of the eye, killing the animals at varying periods of time afterwards. They have also introduced the infected cornea of the rabbit beneath the skin of the eyelid in apes and a chimpanzee, and examined the tissues for spirochaetes by the Levaditi method. They have formulated the following conclusions. The period of inoculation which precedes the manifestation of the primary syphilis of the monkey and the specific keratitis of the rabbit is not due to the existence of an evolutional cycle of the *Treponema pallidum.** It corresponds to the slow but progressive histological lesions provoked by the pullulation of the microbe of syphilis. This multiplication is not marked at first, in consequence of a defective assimilation caused, on the one hand, by a change of medium, and, on the other, by the conditions which preside over the supply of nutritive materials. But, as soon as the vessels and new-formed cellular elements assure to the treponemes the nutritive principles of which they have need, the multiplication by the parasite becomes active, and puts an end to the period of incubation. Again, Boidin and Weil have reported a most interesting case of a young man, aged 18, who had (1) a hard chancre in the middle of June ; (2) headache the middle of July ; symptoms of meningitis and lymphocytosis of cerebro-spinal fluid, August 5 ; roseolar rash, August 12. Cure of the meningitis by inunction, August 17. See also a case of mine, p. 169.

The organisms after the local development at the point of inoculation soon reach the nearest lymphatic glands, where probably they again multiply in the lymph sinuses and spaces, setting up an adenitis ; these changes may be biological, provoked by the organism for its perpetuation, and not, as taught, in the nature of a defence on the part of the tissues against the invasion by the organism. The living organisms usually prevail and pass into the general lymph stream, causing polyadenitis and an infection of glands remote from the seat of inoculation. The organisms may thus find their way into the thoracic duct, and a general infection of the blood stream takes place, with the development of the secondary eruption (roseola). Moreover, a profound biochemical change occurs in the blood and fluids of the body (vide p. 192).

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* *Treponema pallidum* is a synonym of *Spirochaete pallida.*

Occasionally, as first pointed out by Lang, and as I myself have observed (vide case, p. 10), quite early in the disease, even before the primary sore is healed, symptoms pointing to meningitis may occur ; also, as will be pointed out later, and which I have seen illustrated by many examples, the most severe and the most intractable cases of brain and spinal syphilis occur within the first twelve months after infection; it is therefore quite probable that the meninges were infected at the time of the roseolar rash in some of these cases, but the nervous symptoms occurring then were slight and overlooked. Occasionally severe symptoms of meningitis have occurred within a few months of the primary sore. It is reasonable to suppose that if the spirochaete is the cause of the secondary cutaneous eruption by a sort of metastatic process in the skin capillaries, that the same may occur in the meninges. The following case reported by Gautier and Maloizel is interesting in this respect, and tends to support that conclusion. A young woman affected with secondary syphilis had seven successive attacks of cutaneous eruption, simultaneously with sudden fever, headache, stiffness of the neck, and vomiting, accompanied by lymphocytosis of the cerebro-spinal fluid—in fact the group of symptoms of syphilitic meningitis. It is a pity that some of the fluid of such cases was not used for experimental inoculation of an ape. So far only Hoffmann has succeeded in showing that the cerebro-spinal fluid may be infective, for he has successfully inoculated a monkey with the cerebro-spinal fluid obtained blood free and taken with all precautions from a man suffering with a papular syphilide. Neisser states that Dohio and Tanaka have found spirochaetes in the cerebro-spinal fluid in the case of a patient with a papular eruption ; a second examination, as well as one by Neisser himself, was unsuccessful. It may be that centrifugalizing a fluid of such low density would disintegrate such delicate organisms. Again, we know that it is not infrequently impossible, except by culture or inoculation, to find tubercle bacilli in the cerebro-spinal fluid of tubercular meningitis. Until experimental investigations have been made with fluid obtained from early acute cases of syphilitic meningitis, the failure to discover spirochaetes by microscopic examination and unsuccessful experimental inoculation is no valid argument against their being the cause of the meningitis. It may be said that if the spirochaetes are the cause of the meningitis, they could be shown in sections or in films of the exudation. It is seldom however that syphilitic meningitis is rapidly fatal, and cases would rarely come under early enough observation; moreover, not more than 1 or 2 per cent. of syphilized persons suffer with *obtrusive* symptoms of meningitis, and they seldom die in consequence thereof, and still more rarely do they die for at least some months after the onset of symptoms. I have been unable by the silver or Giemsa method to find spirochaetes in the exudation of typical cases of syphilitic meningitis. But I was unable to find trypanosomes in the similar cell-infiltrations of the meninges and perivascular spaces of sleeping sickness, although I have examined quite a thousand sections obtained from thirty cases. Yet, it cannot be doubted that the *Trypanosoma Gambiense* is the exciting cause of the meningo-encephalitis. But the reader is referred to the recent investigations by Ranke in the chapter on hereditary syphilis, p. 434.

Syphilis is characterized by its being an eruptive malady following the inoculation of the virus, presumably the spirochaete of Schaudinn, and by the possibility during the remainder of the life of the individual of fresh eruptions occurring in connexion with the existence of the virus in the body. A blow may be followed by a gumma, or a syphiloma may occur spontaneously in any part of the body at any period of time after infection. Microscopic examination shows that essentially the same tissue reactions occur in these late manifestations of syphilis as in the primary or secondary stages. It is well known that tertiary lesions are, as a rule, non-infective; consequently, we should not expect to find the active agent, or what we believe to be the active agent—*Spirochaete pallida*—except in a few instances, and then only in small numbers. This is actually what has occurred. For a long time attempts to prove the existence of the spirochaetes in tertiary lesions failed, and this led to the not unwarrantable view (which may be true) that the organism may exist in a latent and attenuated, possibly intracellular form, and it is possible that late manifestations may be the result in some cases of secondary lesions which have remained latent until raised into activity by some exciting factor, such as exposure to cold, trauma, and toxoemia—microbial or otherwise. For, at any period after infection such a syphilitic meningitis may occur. On p. 437 I have described a case of congenital syphilis in which cerebro-spinal meningitis occurred in a girl of 16. I was unable, however, to find spirochaetes, although the meningitis was very active and typically syphilitic in its histological characters. It must be admitted that this is a part of the micro-biology of syphilis which is unsatisfactory. The spirochaete, however, has, in a few instances, been found in a gummatous tumour. Schaudinn found it in a gumma of the liver. Blaschko recently claims to have discovered spirochaetes in scrotal papules which occurred sixteen years after infection. Reuter and Schmorl have found spirochaetes in syphilitic aortitis embedded in the proliferated intima between the fibrils, sometimes in places in which regressive changes are absent. Moreover, Benda has demonstrated, typical spiral, straight, and granular forms of the spirochaetes in the external layer of the media, and still more in the connective tissue adjacent to a patch of syphilitic endarteritis. Just as there are, relatively, but few successful observations proving the existence of spirochaetes in tertiary lesions, so there are, relatively few successful experiments of inoculation of animals from tertiary lesions. Hoffman succeeded in inoculating an ape from a gumma occurring in a man three and a half years after primary infection. It has already been stated that the *Spirochaete pallida* is an organism between a bacterium and a protozoon, and in spite of the divergent views respecting the classification of spirochaetes, in my judgement, there are more characters linking them to the protozoon than to the bacterium. The *Spirochaete pallida* contracts, moves, and modifies its structure in a manner different to a bacterium. The appearance of resting forms is totally different, and they arise in a different manner to the spores of bacteria (Prowaczk). Again, the clinical aspects of affection from spirochaete invasion differ from that of bacterial diseases, and conform especially to certain trypanosome infections. There is a periodicity of the symptoms altogether unknown in bacterial diseases. But, what has struck me from my own personal experience and knowledge, is the great similarity of the histological lesions of the nervous tissues of chronic trypanosome infections, e. g. sleeping sickness and dourine to syphilitic and parasyphilitic lesions. Spielmeyer has obtained by experimental trypanosome infection of dogs, a lesion of the posterior columns of the spinal cord simulating the ataxic lesion; he has also produced optic atrophy. Again, there is similarity in the fact that lymphocytes and plasma cells are found in the cerebro-spinal fluid in trypanosome diseases of animals and man, e. g. sleeping sickness. Moreover, Levaditi has shown that, in point of view of sensibility in respect to haemolyzing poisons, blood corpuscles, spirochaetes, and protozoa constitute a homogeneous group, and the spirochaetes correspond in this respect more to the protozoa than the bacteria. It is probable that the periplasium of these protozoa contain a complex of lipoid substance similar to red blood corpuscles and animal cells generally.

The study of all these diseases is primarily biological. The contagium vivum is a living organism whose activities, like that of all living organisms, are for self-preservation and the preservation of the species. The chemical toxin which the organism produces is to enable it to live and multiply. The spirochaetes consist of a viscid plasm covered with a membrane which serves as a means of osmosis. This osmotic membrane is a lipoid substance, like that which forms the membrane of the red corpuscles, and is sensitive to haemolyzing substances. The blood serum of syphilitic persons, and especially tabetics and paralytics, contains a large increase over the normal of lipoids. Blumenthal finds an increase of lecithin in the faeces in tabes and general paralysis and a great diminution in the bone marrow. He considers paralysis and tabes to be due to a poverty of lecithin.

The fact that Castellani (' System of Syphilis,' vol. iii, p. 130) has discovered a spirochaete, which he terms *Spirochaete pallidula*, in yaws is of importance in showing that a spirillar organism not quite identical morphologically with that of syphilis is probably capable of producing a chronic disease in many of its features not unlike syphilis. It might be argued that all the postulates laid down by

Koch have not been fulfilled, and, therefore, that we have no right to claim that the *Spirochaete pallida* is the specific organism of syphilis. Thus the organism, although it has been grown in celloidin capsules, has not been cultivated on an artificial medium outside the body, and the disease reproduced by injection of such a culture. But the same argument might be applied to established protozoal diseases, e.g. malaria, sleeping sickness, and dourine, or *mal de coit* of horses. This latter disease may almost be regarded as the syphilis of equines, for it is characterized by an infective sore on the genital organs, affection of the nearest lymphatic glands, then infection of the blood stream followed by successive eruption of plaques and, as in syphilis so in dourine and sleeping sickness, the juice of the lymphatic glands, in a condition of acute swelling, shows the specific organisms more readily than the blood films. The trypanosomes may disappear from the blood entirely, even without the administration of drugs, and reappear, giving rise to an irritating eruption of papules and fever, and the trypanosomes can be found in smears obtained by scarifying the papules more readily than from smears of the blood. This was demonstrated by Lingard in the case of dourine, or mal de coit of horses, and by the French observers in a case of sleeping sickness. So, also, in syphilis I have been able to find an abundance of spirochaetes in the secondary papules of the skin, although I was unable to find them in the same cases in the blood films. It is a remarkable fact that Neisser was unable to inoculate animals by injecting the virus into the blood or into the organs. Success was only obtained by scarifying an epiblastic skin surface and rubbing in the virus. This is precisely the seat of eruptions and multiplication. It looks as if the organism, to perpetuate the species, must find its way out of the body in the way it came in. Sir Patrick Manson (Huxley Lecture) expressed the opinion that, by analogy, we must presume that trypanosome diseases are carried by some biting insect which acts as alternate host. But dourine spreads in the same way as syphilis. It is quite possible that the *Trypanosoma Equiperdum*, which differs very little from the *Trypanosoma Evansii*, may be this trypanosome which has acquired the habit

PLATE I.

1. *Spirochaete pallida* in a smear preparation taken from a condyloma, stained by Giemsa's solution. Magnification 3,400.

2. Another portion of the smear showing appearances of two spirochaetes twisted around one another; possibly this is the result of longitudinal fission. Magnification 3,400.

3. *Spirochaete pallida* from smear preparation of mucous tubercle. Magnification 1,500.

4. Section of spleen from a case of congenital syphilis, stained by Levaditi's method. Magnification 1,400.

5. Blood smear from a case of sleeping sickness, showing *Tryp. Gambiense.* Magnification 2,000.

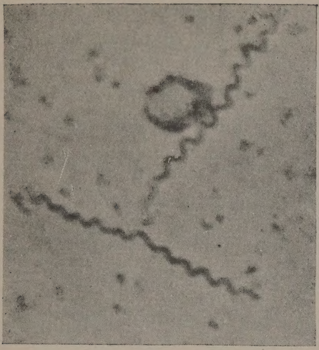
6. Blood film showing *Tryp. Brucei.* Magnification 1,700.

7. Section, showing spirochaetes, of a papule of skin from a case of secondary syphilis, before mercury was administered. Stained by Levaditi's method. Magnification 1,000.

It will be observed that it would be difficult to decide the nature of the two trypanosomes by morphological characters alone.

To face p. 28.]

PLATE I



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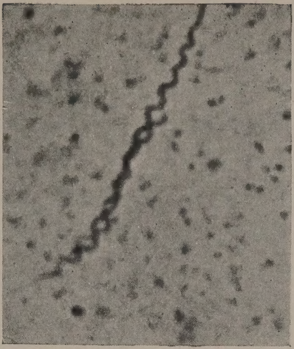

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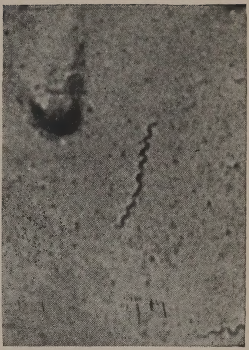

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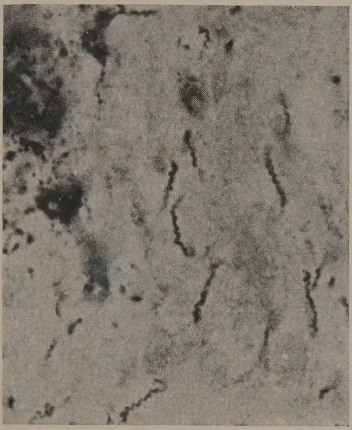

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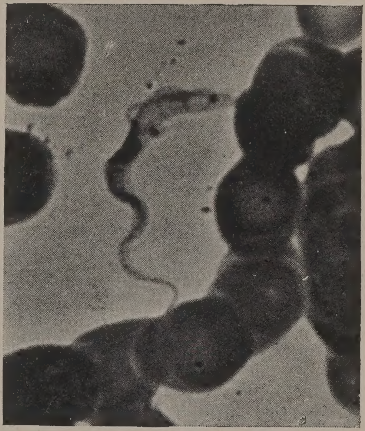

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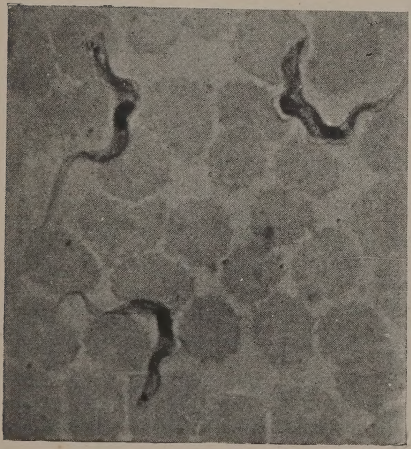

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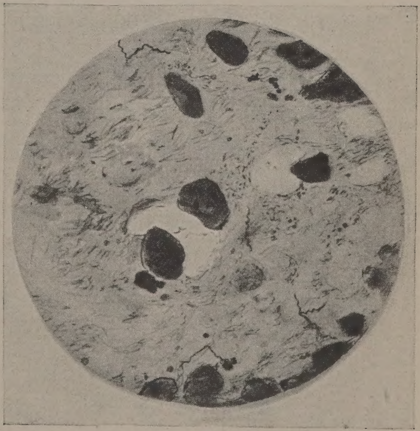

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of pullulation in the mucous cutaneous orifices, and when infection occurs, always tends to get back there; in syphilis the same habit may have been acquired. It is known that mucous tubercles and condylomata (secondary eruptions) are more infective than the primary sore, and contain immense numbers of spirochaetes.

Similarly, upon reading Lingard's experiments, I find he mentions that the *Trypanosoma Equiperdum* was found in great abundance sometimes in the vaginal mucus when it could not be found in the blood. Again, he was more successful when he inoculated animals by scarifying the genitals and inoculating with blood from a papule or with vaginal mucus than when he injected the blood into animals. Those facts accord very much with Neisser's experiments, and would seem to indicate that a habit had been acquired by the *Trypanosoma Equiperdum* of developing in the mucous membrane of the genital organs and of using this acquired habit as the means of preserving the species.

Finally, the therapeutic agents, mercury and arsenic in the many forms employed, are specific for both trypanosome and spirochaete affections. They are not of much use for bacterial infections. Mercury, particularly in the form of inunction, is especially valuable, and this may be owing to the fact that it prevents the multiplication of the spirochaetes on the surface of the body, including the mucous orifices, a habitat which these organisms have found particularly favourable for perpetuation of the species by transmission to another individual. Mercury, moreover, administered in any way, tends to come out by the skin and mucous membranes, as can be readily demonstrated.

I have pointed out that, practically, the morbid tissue-changes in syphilis are similar, whether the lesion be the primary sore or a gumma twenty years later; moreover, it is difficult to understand how the spirochaete, seeing that it has hardly ever been found in tertiary lesions, can produce the same specific cell hyperplasia so long after the primary infection. The following hypotheses may be put forward to explain the phenomenon of a gumma appearing spontaneously in the central nervous system long after the primary sore and apparent cure of the disease :—

1. The spirochaete, or some modified form of it, has remained

latent in the tissues at the seat of the lesion, and, for some reason, inherent or otherwise, the resistance of the tissues at that particular spot has become lowered, and the organism has exerted again its specific activity—possibly in some not yet discovered intracellular form.

2. The specific organism has remained latent in some other tissue, e. g. the marrow of bone, the spleen or glands, and, escaping into the blood or lymph circulation, has, like a new growth, engendered a metastasis, which has developed and increased, producing a hyperplasia of the fixed tissue cell elements conjunctival and endothelial.

3. There may be varieties of specific spirochaetes, one of which may have an elective affinity for the central nervous system, as we know the *Trypanosoma Gambiense* has. It is difficult to differentiate this trypanosome from other forms by morphological appearances (vide Figs. 5 and 6, Plate I); how much more difficult would it be to differentiate varieties of *Spirochaete pallida.*

4. The invasion of the body by the spirochaetes has altered the blood and lymph biochemically, so that the tissue reactions to all causes which would lead to injury may take on the specific character; thus a blow on the head, vascular stasis, or some inherent weak spot may become the seat of a gummatous process.

We have seen then that trypanosomiasis corresponds with syphilis in being a disease characterized by successive eruptions due to escape of trypanosomes from the blood stream into the lymph spaces of the tissues where they set up a similar tissue reaction. Moreover, in severe trypanosomiasis as in severe syphilis there is always a polyadenitis. In the central nervous system of sleeping sickness there is a chronic lymphangitis affecting the membranes and perivascular spaces, due no doubt to the escape of the trypanosomes from the blood stream into the lymphatics in the same way as they escape in the vessels of the skin; they set up in the perivascular lymphatics a defensive cell reaction by conjunctival and endothelial hyperplasia. The nuclei of the connective tissue cells of the pial sheath and the endothelial cells of the lymphatics and lymphatic spaces proliferate, forming lymphocytes and plasma cells which surround and wall in the invading parasites. Some of the endothelial cells become mobile macrophages and take up in their interior the dead trypanosomes, and macro-nuclei and micro-nuclei can be seen as inclusions ; and just as in the lymphatic glands, the newly-formed cells, after a time, undergo plasmolysis and nucleolysis ; there is in fact a granulo-aqueous degeneration. Meanwhile the neuroglia cells proliferate and increase in size, and large branching spider cells tend to form, especially around the small vessels to which the pial sheath has not extended. Polymorpho-nuclears are usually absent. The lesions of sleeping sickness, however, differ from syphilitic meningo-encephalitis mainly in the fact that there is no tendency to endarteritis or the formation of definite tumours (gummata) or nodules. It is known that as soon as the *Trypanosoma Gambiense* has found its way into the cerebro-spinal fluid, the central nervous system is affected ; it is quite possible that this organism with an undulatory membrane finds the cerebro-spinal fluid a suitable medium for multiplication as there are no phagocytes to combat with. I have found that the earliest site of the cell hyperplasia and that where it is most extensive, is around the perforating arteries of the base of the brain where the perivascular spaces are largest ; in fact, the whole of the structures about the base of the brain. In this respect it corresponds to syphilis for it is here that the gummatous meningitis is most intense. Both in syphilis and sleeping sickness, however, the location of the evidence of most severe irritation in the region of the base of the brain may be due to direct extension along the lymphatics of the large arteries and nerves entering the base of the skull. In trypanosome infections I have never seen endarteritis, although there is an intense perivascularitis. We may have a granulo-aqueous degeneration of the lymphocytes and plasma cells in the perivascular spaces, but I have never seen caseation, nor have I seen tumour formation. This looks as if the trypanosome when it was surrounded by cells in the perivascular space did not undergo division but was rapidly killed as soon as it escaped from the blood. Whereas the gumma starting in the meninges and spreading inwards along the pial sheaths, as well as superficially, suggests that the virus multiplies and spreads, successively setting up fresh cell hyperplasia in the endothelial and connective tissues (including neuroglia) with the formation of lymphocytes and plasma cells; but inasmuch as the walls of the arteries participate in this cell hyperplasia endarteritis occurs and this together with the rapid cell proliferation leads to the older and more central portions of the tumour being cut off from nutrition; consequently a necrobiosis with the formation of amorphous granular detritus occurs. A zone of more vascular tissue exists around this, and here the newly-formed cells are crowded together. They may be round, in the advancing edge of the tumour and consist of lymphocytes and large and small plasma cells with new capillaries forming a crown or halo to the margin of the tumour; inside this the cells may be oat-shaped, spindle-formed or stellate fibroblasts mingled with numbers of cells which are undergoing plasmolysis and nucleolysis. This zone is tending to the formation of dense fibrous cicatricial tissue and if the morbid process is arrested in its progress, a dense fibrous capsule is formed. It is obvious such a neoplasm will irritate and destroy the neural structures involved and the effects will be proportional to the extent of the process and the functions of the parts involved. Trypanosome infections do not produce tumour formations and do not produce endarteritis, consequently there is not neural destruction but neural exhaustion; but in some cases there may be systemic neural degeneration owing to the lymphangitis and toxaemia interfering with the nutrition and vitality of the neurones. Thus in dourine we may have a degeneration of the posterior roots and posterior columns simulating ataxy. Spielmeyer claims to have produced experimentally optic atrophy and ataxic lesions of the posterior columns in animals by chronic trypanosome infections. Possibly, therefore, the chronic trypanosome infections more closely resemble the diseases which are termed parasyphilitic, but according to my experience which is a large one [I have examined the nervous system in over thirty cases of sleeping sickness], no chronic

PLATE II.

1. Section of a small vessel showing the sheath infiltrated with lymphocytes, plasma cells, and proliferated glia cells. Experimental sleeping sickness in an ape. Magnification 320. (Cf. Fig. 3, Plate III.)

2. Section of cortex cerebri from a case of sleeping sickness in a European. Stained to show the neuroglia. Magnification 450.

3. Section of brain of an ape infected with *Tryp. Gambiense*, showing perivascular neuroglia cell hyperplasia. Below are seen a series of neuroglia cells in various stages of development. Magnification 320. (Cf. Fig. 4, Plate III.)

4. Perivascular infiltration with lymphocytes and plasma cells from a case of gummatous cerebro-spinal meningitis. Stained by polychrome blue. Magnification 250.

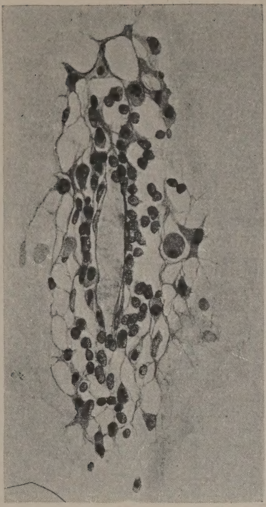
5. Section of Central Nervous System from a case of sleeping sickness in a European, showing perivascular infiltration with lymphocytes and plasma cells Magnification 250.

Compare the histological changes with those of Plate III.

To face p. 32.]

the blood. Whereas the gumma starting in the meninges and spreading inwards along the pial sheaths, as well as superficially, suggests that the virus multiplies and spreads, successively setting up fresh cell hyperplasia in the endothelial and connective tissues (including neuroglia) with the formation of lymphocytes and plasma cells; but inasmuch as the walls of the arteries participate in this cell hyperplasia endarteritis occurs and this together with the rapid cell proliferation leads to the older and more central portions of the tumour being cut off from nutrition; consequently a necrobiosis with the formation of amorphous granular detritus occurs. A zone of more vascular tissue exists around this, and here the newly-formed cells are crowded together. They may be round, in the advancing edge of the tumour and consist of lymphocytes and small plasma cells with new capillary formation, or at the margin of the tumour inside this there may be spindle-formed or stellate fibroblasts mingled with remains of cells which are undergoing plasmolysis and nucleolysis. This zone is tending to the formation of dense fibrous connective tissue, if the morbid process is arrested in its progress, and a capsule is formed. Otherwise such a neoplasm will irritate and destroy the neural structures involved and the effects will be proportional to the extent of the process and the functions of the parts involved. Trypanosome infections do not produce tumour formations and there is not neural destruction but neural exhaustion; but in some cases there may be systemic neural degeneration owing to the lymphangitis and toxaemia interfering with the nutrition and vitality of the neurones. Thus in dourine we may have a degeneration of the posterior roots and posterior columns simulating ataxy. Spielmeyer claims to have produced experimentally optic atrophy and ataxic lesions of the posterior columns in animals by chronic trypanosome infections. Possibly, therefore, the chronic trypanosome infections more closely resemble the diseases which are termed parasyphilitic, but according to my experience which is a large one [I have examined the nervous system in over thirty cases of sleeping sickness], no chronic

PLATE II



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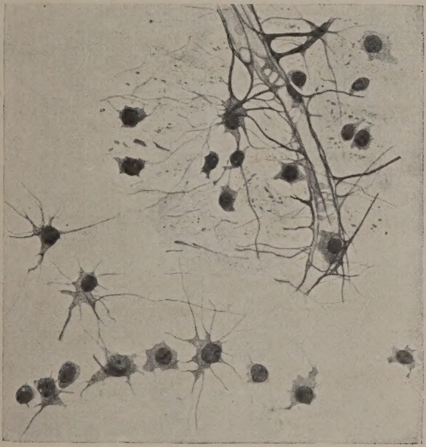

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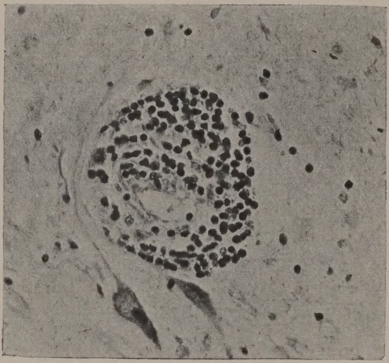

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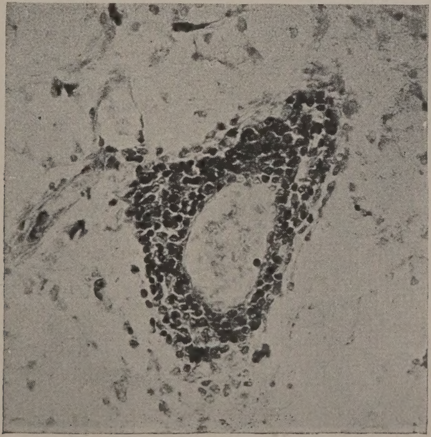

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PLATE III.

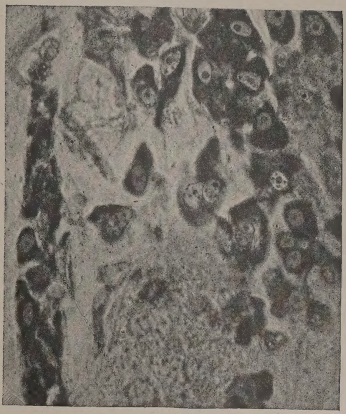
1. Photomicrograph of a section of the ascending parietal convolution from the brain of a case of general paralysis of four years' duration, showing a small vein surrounded by plasma cells lying in the perivascular lymph space. The vessel at another part had ruptured and filled the perivascular space with blood-corpuscles. Some of the large swollen cells contain blood pigment in various stages of disintegration; they are probably of endothelial origin and have a phagocytic function. Magnification 500.

2. Section of a recent syphiloma of the pons showing a small vessel with (*e*) thickened endarterium, (*l*) lymphocytes, (*p*) plasma cells. Magnification 300.

3. Section of small subcortical vessel, acute general paralysis, (*l*) lymphocytes, (*p*) plasma cells, filling the perivascular space. Note the similarity of this perivascular infiltration to that of sleeping sickness and syphilis, Plate II. Magnification 300.

4. Small vessel, from a case of acute general paralysis, showing neuroglia cells with proliferating nuclei and processes extending on to the small vessel. As in sleeping sickness, there is little or no lymphocyte and plasma cell infiltration around, because there is no pial or lymphatic sheath. Magnification 400.

To face p. 32.]



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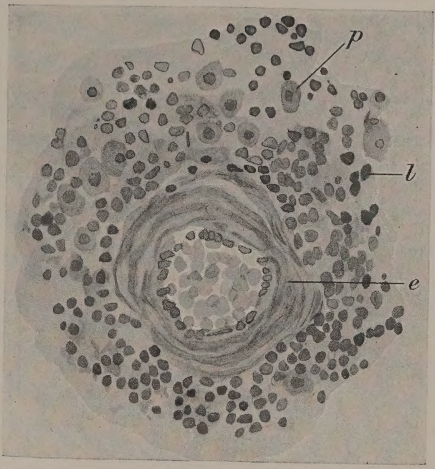

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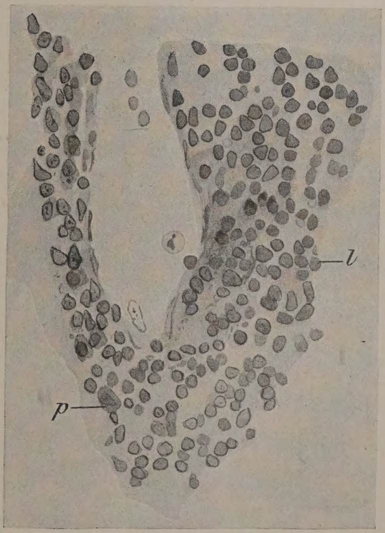

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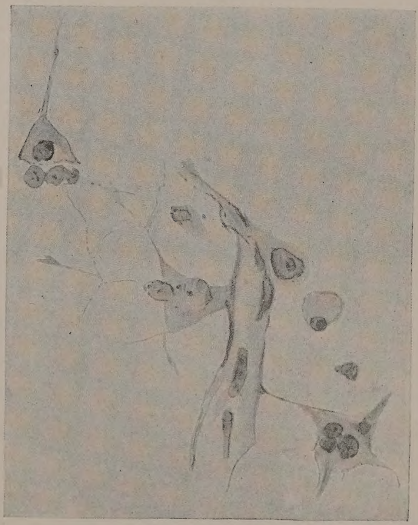

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trypanosome affections show the wasting and destruction of the neural elements to anything like the extent of general paralysis. Yet microscopically there are many features of striking resemblance in the histological changes seen in the sections of brains affected with acute general paralysis, brain syphilis, and sleeping sickness (vide Plates II and III). There is an infiltration of the meninges and perivascular spaces with lymphocytes and plasma cells in all these diseases; but it is much more widespread in the trypanosome infection. The decay and destruction of cells and fibres in the case of general paralysis is much more extensive; although lymphocyte and plasma cell infiltration and neuroglia infiltration may be much more extensive and widespread in the sleeping sickness. This would accord with the clinical symptoms; for in the latter disease the signs point to neural exhaustion rather than destruction. Moreover, it indicates that the primary decay of the neurone is the essential feature of general paralysis, although by the establishment of a vicious circle, numbers of cells may be destroyed by congestive stasis in the vessels. The disease is essentially a loss of durability of specific energy of the cortical cells latest developed and whose function especially is association and co-ordination. For this reason I do not agree with Bosc, Lesser, and Hirschl in regarding general paralysis as quaternary syphilis, a late manifestation of the action of an attenuated virus, similar to the gummatous process, only delayed in its appearance, and due to the virus setting up a perivascularitis with lymphocyte and plasma-cell infiltration and neuroglia proliferation, *slower and more diffuse*, but otherwise similar to a diffuse gummatous meningo-encephalitis (vide Figs. 1, 2, 3, 4, Plate III). If it be so, the cell and fibre destruction is out of proportion to the perivascular changes. Moreover, it is very rare to find extensive endarteritis or gummatous syphilitic lesions in true general paralysis. In my opinion the perivascular and meningeal infiltration, the formation of new capillaries and the neuroglial proliferation are associated with the decay and death of the neurones; the specific products of decay and the necessity of filling up the space occupied by the destroyed neural structures, together serve as the stimulus to a secondary proportional formative proliferation of the nutrient and supporting tissues. In chronic trypanosome diseases, where there is primary intense meningeal and perivascular change, there is in comparison with general paralysis but little neural destruction and the meningo-encephalitis is due directly or indirectly to some toxin produced by the trypanosomes.

A theory will be advanced later for the explanation of this process of dystrophy or abiotrophy in tabes and general paralysis. But to return to the syphilitic lesions, the histological changes in the tissues, whether observed in the primary sore, the secondary eruptions, or the so-called tertiary lesions (gummata), are practically all the same. The lesions are essentially a nodular perivascular lymphangitis extending to the lymph spaces and crevices of the adjacent tissues and thence to the lymphatics along which the morbid process extends. In the lymph spaces and crevices (saftcanälchen) the spirochaetes multiply and increase, setting up a proliferative hyperplasia of the fixed tissue cells, endothelial, epithelial, and conjunctival.

Although the spirochaetes have been demonstrated in the secondary eruptions, and occasionally shown in so-called tertiary lesions, all attempts to demonstrate the organisms in tabes and general paralysis have failed, and if the view I have taken of the pathology of these parasyphilitic affections be the correct one this failure is not unexpected.

As there is no histological difference in the neoplastic formation of a gumma when first formed, even though it occurs even twenty or more years after the primary infection, and lesions in which the spirochaetes can easily be demonstrated ; are we right in assuming that the former is not caused by the same specific agent in a modified form, not at present demonstrable by microscopic methods or experimental inoculation ? Virchow demonstrated the fact that the virus of syphilis always attacked the *locus minoris resistentiae.* We know that a blow will cause a localised gummatous meningitis many years after the primary infection, and experience teaches that mercurial inunction or injection will arrest the progress of the disease. I have observed in gummatous pachymeningitis that relief of the pain may be obtained by local application of mercurial ointment, this may be due to the fact that direct absorption of the mercury at the seat of the lesion stops the growth of the syphilitic virus which is causing the irritation of the meningeal nerves. The value of mercury as a therapeutic agent is undoubtedly its destructive action on the virus, and when the patient's gums are really affected there is probably sufficient mercury in the lymph and blood so to assist the natural defences of the body as to prevent the multiplication of the spirochaetes, but only prolonged mercurial treatment will lead to the entire destruction of the organisms ; and even a long course in some individuals has but little effect on the disease, or may leave some syphilitic organisms in a resting stage lurking in the body, probably in the lymphatic glands, ready to reappear in tissues where there is a lowered vital resistance.

In this respect syphilis resembles two other protozoal diseases, viz. malaria and trypanosomiasis. Metchnikoff says, 'the cause of the disappearance of the spirochaetes has not been settled, and it is quite possible that the action of mercury is towards strengthening the defences of the body rather than any direct lethal action on the organisms themselves. The work of several observers has indicated that atoxyl does not kill the organisms but exerts its influence in strengthening the phagocytic defences of the host.' Iodide of potassium is a most valuable therapeutic agent in all gummatous processes ; it probably does not act as a specific agent like mercury in killing the living virus, but by the change which it produces in the electrolytes of the blood and lymph it favours the process of plasmolysis and nucleolysis of the neoplastic formation, and promotes the absorption of the products of granulo-aqueous degeneration. Thus it is most useful in promoting the absorption of the gummatous formations.

It was formerly taught that the brain and other internal organs were only affected in the tertiary period and this doctrine of Ricord was fraught with the greatest mischief. Virchow showed that pathologically all the lesions of syphilis were of the nature of an infective granuloma. In the light of modern discovery and by analogy with the closely-allied trypanosome infections we may regard syphilis as a general micro-organismal invasion of the body from a point of inoculation of the lymph stream, secondary invasion of the blood stream, polyadenitis and eruptions by migration of the parasites from the blood stream to the perivascular lymphatics of the skin, mucous membranes, viscera, and meninges. As already pointed out there is probably some anatomical or biological reason why the eruption occurs more frequently on the skin than on the meninges.

Congenital syphilis of the nervous system produces the same pathological changes, neoplastic formation, peri- and endarteritis, gummatous meningitis, and tumours, as acquired syphilis, and it would be surprising if this were otherwise.

Cerebral Gumma and Gummatous Pachymeningitis

Case 3. M. A. H., age 42, a widow, was admitted to Claybury Asylum, June 14, 1907. The certificate states that she was suffering from suicidal mania, she is noisy, restless, and has to be closely watched to prevent her injuring herself. She has tried to strangle herself with the bandages.

She has had eight pregnancies, only one child is alive. The pupils are irregular with sluggish reaction to light, but react to accommodation; the knee jerks are markedly exaggerated and there is muscular tremor; she exhibits marked psycho-motor restlessness, and is incoherent, abusive and resistive; she has no idea of time or place; the memory is poor and there is marked mental confusion although she is voluble in conversation, but there is marked dissociation of ideas.

Further notes. The speech is hesitant, and she is unable to utter difficult words, she slurs the syllables. She has varied complaints about her head and mouth, and asks to be made 'a bright woman'; she thinks if 'she had her gums lanced' she might get well; she rambles incoherently and there is marked mental impairment; she has no knowledge of time or place; she is inclined to be suicidal and has attempted to put her hands down her throat, *possibly* because she feels ill; she is in fair nutrition but impaired health; her habits are defective; she cannot stand and has to be wheeled about in a chair; she says

PLATE IV.

Gummatous tumour of the Falx Cerebri, producing adhesions between the membranes and the mesial surface and upper border of the right hemisphere. General syphilitic pachymeningitis of the posterior part of the hemisphere as shown by the decortication on stripping the thickened membrane from the surface. The cortex appears red and inflamed over the occipital and temporal lobes, and the thickened membranes show the brain substance adherent to their surface.

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PLATE IV.

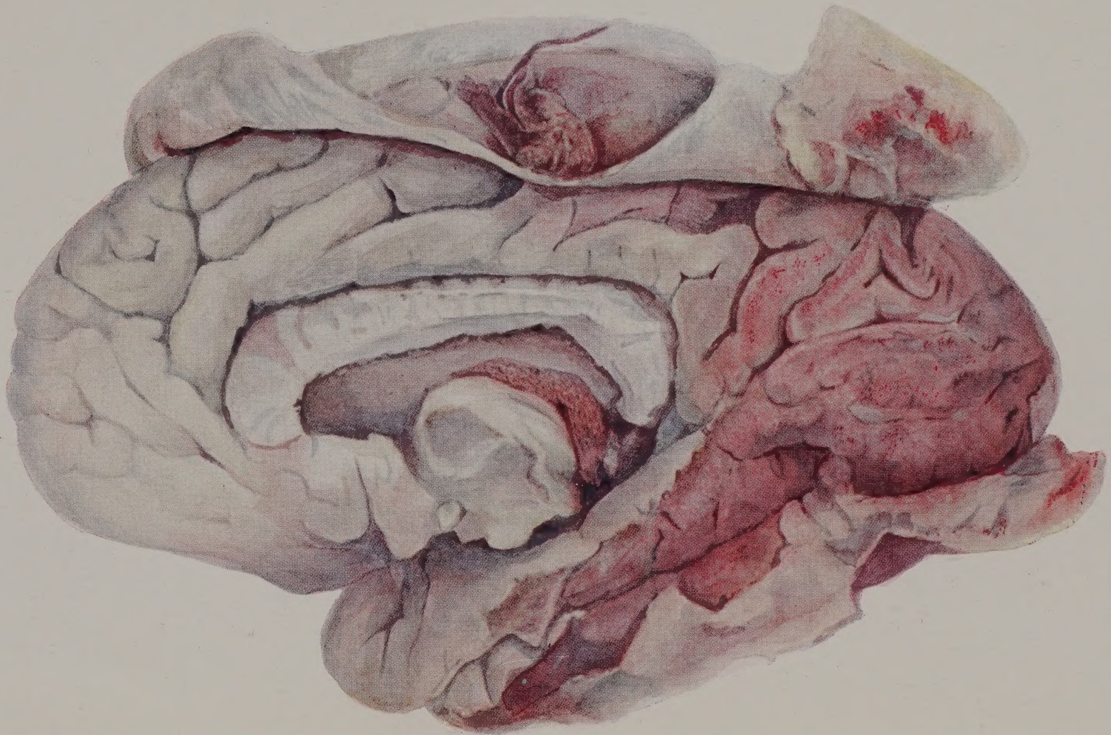

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PLATE V.

Gumma of Falx Cerebri. A section through the gumma, stained with logwood and eosin, magnified 50 diameters, showing the different appearances in structure according to the age of the neoplastic formation. × 50.

A, B, and C on the right-hand side represent portions of the syphiloma more highly magnified. *A* shows (*l*) a lymphocytic infiltration of the fibrous tissue and fibrous tissue formation. *B*, Degenerative nucleolysis and plasmolysis of the cell elements. *C*, a portion of the growing edge of the growth with (*l*) lymphocytes, (*pl.c.*) plasma cells, and (*b.v.*) blood vessels. × 600.

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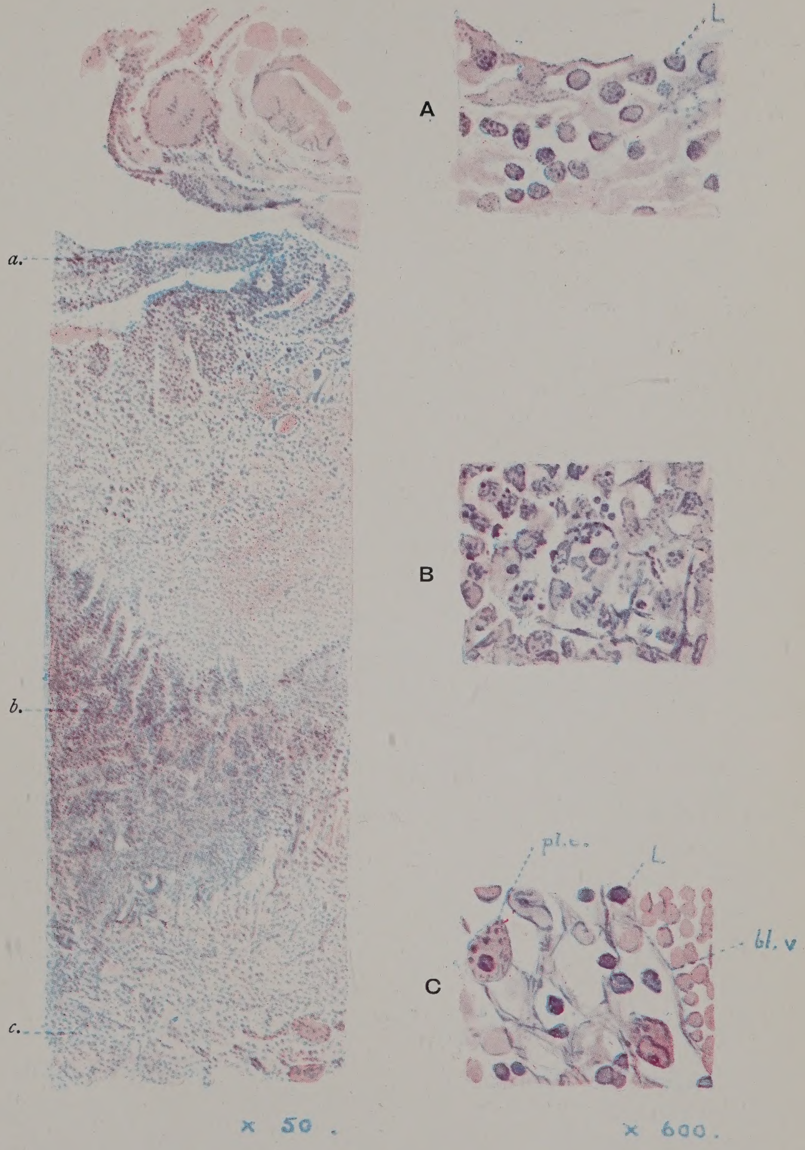
PLATE V.


a.
b.
c.
× 50.
A
L
B
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she cannot do anything with her hands lately. The left pupil is dilated and both are inactive to light.

There were no notes recording the condition of the fundus, possibly she was too difficult to examine; there is no note saying that she suffered from vomiting. She died exactly one month after admission of broncho-pneumonia. She was looked upon as a case of probable paralytic dementia.

Summary of post-mortem notes. The cause of death is given as gummatous meningitis, broncho-pneumonia, dilated heart and cirrhotic liver; the liver weighed 1,820 grams, it was fatty, friable, and fibrotic. On removing the calvaria, the dura mater was found to be adherent over the posterior three-quarters of the right hemisphere; there were also adhesions between the mesial surfaces of the two hemispheres in the posterior half; on removing the dura mater on the right side the latter adhesions were found to be due to a gummatous mass about 2·5 centimetres in diameter as shown in Plate IV. All the membranes were fused together, much thickened and firmly adherent to the surface of the convolutions of the posterior half of the right hemisphere; the surface of the cortex was lacerated on attempting to strip the membranes and much of the grey matter was left adherent to the membranes on so doing (vide Plate IV). The microscopic examination showed that the lesion was a gummatous syphilitic meningitis (vide Plate V).

It is probable that alcoholism played an important part in the production of the symptoms, for the paralysis in both lower limbs and the inability to use the hands combined with the mental symptoms like Korsakoff's psychosis may be correlated with the fact that she had well marked (alcoholic) hypertrophic cirrhosis of the liver. The brain weighed 1,230 grams. The right hemisphere weighed 565 grams; the left 520; the cerebellum, pons, and medulla, weighed 150 grams; the ventricles exhibited no granulations. No doubt the right hemisphere weighed 40 grams more owing to the syphilitic neoplasia; the fact that the cerebrum was eight times the weight of the cerebellum, pons and medulla is an indication that there was no brain wasting; therefore it may be concluded that the patient did not suffer with general paralysis, but that the mental and bodily symptoms observed were due to the organic brain disease complicated and aggravated by chronic alcoholism.

PATHOLOGICAL ANATOMY OF BRAIN SYPHILIS

Syphilitic neoplasms. Gummata of Virchow or syphilomata of Wagner affect the membranes; they may start in an osteitis or periostitis of the skull or spinal column, and extend to the subjacent membranes, and when they occur on the convexity of the brain it is difficult to say whether the growth had its origin in the dura mater or in the other membranes, as all three are usually adherent in the growth. Sometimes a growth starting in the membranes extends outwards and involves the skull (vide Case 15, p. 87), but a gummatous tumour starting in the meninges almost invariably extends along the pial sheath of the vessels into the subjacent brain. The gumma of the base of the brain almost always starts from the pia-arachnoid and seldom involves the dura mater.

Upon opening the cranial cavity and removing the skull cap a gummatous tumour may be recognized by certain naked-eye appearances and characteristics. There is an elevation of the dura mater if it be situated on the convexity; it may be pinkish from congested vessels, or greyish yellow, or both, and the surface is irregular and nodular (vide Plate IV). On palpation it may be tough and resistant in one part, and soft and succulent in another. On slitting the dura and endeavouring to expose the brain surface, it will be found that a close adhesion of all the membranes to the brain exists at the site of the tumour, and generally for some considerable area adjacent (vide Plate IV). The gummatous tumour, according to my experience, is seldom single; its usual size is from that of a Barcelona nut to a walnut, but it may be as small as a hemp seed, or as large as a tangerine orange. Its consistency varies in different parts, likewise its colour; and this is easily explicable when its microscopic structure is understood. It has an irregular, nodular, warty surface, which at one part may appear pink, at another greyish pink, or greyish, at another, yellow or greyish yellow. At some places it feels succulent, at others firm and tough. On section, areas of caseous yellow material may be seen interspersed with grey strands of fibrous tissue; these are especially noticeable in the central parts of the tumour, which may consist entirely of this caseous material enclosed in a dense fibrous capsule. More often, however, there is an intermingling of caseous foci, grey strands of dense fibrous tissue, and more succulent pinkish grey tissue. Often the circumference of the tumour presents a vascularity which affords a striking contrast to the central non-vascular fibrous and necrotic parts (vide Plate V). Microscopic examination affords an explanation of this variegated appearance of the neoplasm, for if we examine a recent syphiloma the only variegation is due to an increased vascularity in parts; there is no caseous material corresponding to older parts of a growth which have undergone necrobiosis; the neoplasm consists essentially and primarily of a granulation tissue formed by the active proliferation of the connective tissue and endothelial cell elements; it is a mass of embryonic cells, lymphocytes and plasma cells, filling up all the interstices of the groundwork of connective tissue cells (vide Plate V). But these embryonic cells, by the rapidity of their formation and consequent compression of the vessels suffer from denutrition and undergo necrobiosis, leaving behind a dry granular amorphous mass of detritus, containing few fat globules and not proceeding to calcification. In the neighbourhood of the caseous focus may be seen a number of plasma cells and lymphocytes which are undergoing necrobiotic change; in other parts there are strands or even a capsular formation of fibrous tissue, consisting of spindle cells and stellate cells; sometimes this tissue has proceeded to form dense scar tissue, or it is more succulent, and it then consists of connective tissue cells in the meshes of which are numbers of lymphocytes and plasma cells (vide Figs. A, B, C, Plate V). Such tissue is likely to be seen at the growing edge or where it is extending along the pial sheath into the brain substance; it is usually highly vascular and contains new sprouting capillaries, which vessels frequently take the form of a crown surrounding the central older non-vascular portions of the neoplasm. Giant cells have been described by various authors including Baumgarten, who, however, has formed the opinion that the finding of giant cells points to a mixed infection with tubercle. The only case in which I found giant cells was one of multiple gummata, and here there was undoubtedly secondary tubercular infection, for bacilli were found in the giant cells (vide Case 14, p. 89).

The effects of new growths on the brain are twofold; they may serve as a source of increase of the general intracranial pressure, and produce all the general symptoms of tumour; or they may produce local symptoms of irritation when situated in particular regions; or they may produce loss of function by destruction of the neural substance. If the tumour presses upon an artery, or when a large artery is surrounded by the neoplasm—(which is likely to occur when the neoplastic formation is situated at the base of the brain)—then the portion of the brain supplied by the artery may undergo softening.

Arteritis is usually associated with gummata and softening results from occlusion by proliferation of the intima, or thrombosis. When an artery is involved in a gummatous mass its previous existence may be manifest only by the crinkled outline of the elastic lamina.

The *circumscribed gumma* may be situated in practically any part of the brain or spinal cord, it has a predilection for the base; the optic chiasma, or the interpeduncular space are the sites favoured; then cranial nerves, especially the third, may be involved, as also the arteries of the circle of Willis (especially the middle and anterior cerebral). When situated upon the convexity, the seat of predilection is either the frontal or parietal region, but any part of the central nervous system may be the seat of a gumma. I have seen gummata in the basal ganglia, in the ventricles, the peduncles, the white substance, the pons, the bulb, the spinal cord, the cerebellum, and upon the cranial nerves. They are more often multiple than single, and frequently they are combined with a local or diffuse generalised gummatous meningitis. The tumour may be on one cranial nerve only (vide Case 18, p. 99, Plate XIII), and the nerve may be uniformly swollen at one place, or it may be situated on the side of the nerve; as a result, the nerve fibres may undergo complete or partial degeneration. It is a remarkable fact that whereas gummata under the skin rapidly disappear with anti-syphilitic treatment, gummatous tumours of the brain do not so readily undergo resorption by treatment. It is probable that these cases are old-standing neoplasms which have been allowed to go on to the late stages of necrobiosis and fibrosis before anti-syphilitic treatment was tried. A gumma situated in the cortex is often surrounded by a considerable area of fibro-hyperplastic meningitis and encephalitis; the sheaths of the vessels are filled with lymphocytes and plasma cells, and there is a variable amount of destruction or damage of the columns of Meynert, and the systems of fibres in proportion to the extent of interference with the blood supply of the area involved. There is usually, however, far less evidence of neuroglia proliferation than is met with in the meningo-encephalitis of paretic dementia. Occasionally the irritation of a gummatous pachymeningitis may cause a neuroglia hyperplasia without perivascular infiltration (vide p. 90, and Plate VIII).

Diffuse gummatous meningitis may affect all three membranes or be limited to the soft membranes. When the morbid process spreads from a syphilitic osteitis or periostitis to the dura mater it produces a fibrous hyperplasia of the dura, so also when the disease starts in the membranes of the convexity a fibro-hyperplastic meningitis results; the dura mater is several times thicker than normal, and it forms adhesions with the subjacent thickened and infiltrated soft membranes (vide Plate IV). This may be termed *gummatous pachymeningitis*, and it is usually, but not invariably, associated with some degree of encephalitis and possibly also encephalomalacia, if the vascular supply to the brain has been interfered with by the morbid process. A section of the cortex will usually show, as in the case of the circumscribed gumma, infiltration of the perivascular sheaths with lymphocytes and plasma cells extending a variable distance into the substance of the brain along the pial sheaths; there is also thickening and proliferation of the connective tissues of the meninges with fibrous hyperplasia, especially in the superficial dural layers; infiltration with lymphocytes and plasma cells (especially of the pia-arachnoid) and congested vessels, and infiltration of the walls with embryonic cells. There is always some periarteritis, frequently an endarteritis; and usually a neuroglia cell hyperplasia, which may be marked. The sections stained by the Nissl method may show a disorganization or complete destruction of the columns of Meynert; they may show holes from the effect of the hardening fluid on an oedematous tissue, or they may have the appearance met with in softening of the cerebral cortex from vascular occlusion, viz., a meshwork of fibres and branching stellate cells in the interstices of which are round cells, viz., lymphocytes and plasma cells in variable number. The ganglion cells which are not destroyed stain poorly and exhibit a breaking up or disappearance of the Nissl's granules. Stained by Weigert's method, a variable degree of damage or destruction of the medullated fibres is shown. In the parts where fibres exist the whole of the section stains imperfectly purple as compared with the normal. Microscopic examination shows the fibres (especially the more superficial association fibres) either completely destroyed or broken up, imperfectly stained, and evidencing degenerative changes by varicosities and attenuations. In old-standing lesions the neural substance may be replaced by a network of fibres and branching neuroglia cells. In cases which prove rapidly fatal, as in Case 18, p. 99, the brain may show no perivascular infiltration, and the only evidence of irritation is the neuroglia hyperplasia.

I have hitherto spoken of meningitis involving the dura, but the diffuse gummatous *lepto-meningitis of the base of the brain* is the most frequent form of *meningitis syphilitica.* This disease is generally associated with periarteritis and endarteritis, and in fatal cases, according to my experience, is associated with multiple gummatous tumours which may be found in various parts of the brain; the meningitis also frequently extends the whole of the way down the spinal canal, therefore, not only are the cranial nerves involved in the neoplastic formation but also the spinal nerve roots (vide Case 24, p. 113), it is in fact a generalised cerebro-spinal meningitis; indeed in some cases, not even the convexity is spared. The seat of preference, however, is where the cerebro-spinal fluid is most abundant, viz., the interpeduncular space and optic chiasma ; the whole base of the brain and spinal cord in severe cases appears covered with an exudation filling up the fissures, sulci, and crevices; surrounding the vessels, nerves, and nerve roots with a semi-solid substance, as if gelatine or agar culture medium had been poured over and allowed to set. It is very rarely purulent ; when it is so, a secondary microbial infection may be anticipated. The neoplastic formation may have a greyish appearance in some areas ; in others it may appear speckled yellow or pinkish grey—the former indicative of fibrous sclerous formation, the latter of necrobiotic change. Sometimes miliary or warty elevations occur, which may be either fibrous or caseous, or there may be multiple nodular gummatous tumours scattered all over the under surface of the brain. Microscopic examination reveals the same morbid change observed in the circumscribed gumma. There is an infiltration of the lepto-meninges with lymphocytes and plasma cells, this infiltration surrounds all the vessels and their pial sheaths which extend into the substance of the central nervous system ; the infiltration invades the walls of the vessels and produces a thickening of the coats. Appearances indeed suggest that the infiltration commences in the perivascular lymphatics. The round-celled infiltration extends into the perineurium and endoneurium of the cranial and spinal nerves. The optic nerves, the chiasma and optic tract, the motor nerves of the eyeball, any or all of the cranial nerves and spinal nerves, may show a variable degree of infiltration.

The appearance of the neoplastic formation varies in different situations in the same case, according to the time which has elapsed since the process commenced. In some places the cells are young and actively undergoing proliferation, in other places they show a regressive metamorphosis by plasmolysis and nucleolysis ; in some places there are foci of necrobiosis, in others fibrotic sclerosis. The vessels are always involved, and the nervous structures may be damaged by extension of the meningitis along the pial septa, causing encephalitis, but still more seriously by occlusion of the vessels. The end arteries of the base are liable to be affected by periarteritis and endarteritis with subsequent occlusion of the lumen by the neoplasia or by thrombosis. In severe cases in which sclerosing fibrosis has occurred the sclerosis may extend to the subjacent neural substance, or the sclerosis may supervene on degenerative atrophy of the neural elements. A sclerosis or induration of the brain associated with atrophy and defective development of the neural structures may result from a syphilitic meningitis with a diminution, but not abolition of the vascular supply. This sclerosis is met with in congenital syphilitic children the subjects of epilepsy, blindness, deafness, and associated with a mental deficiency, amounting to either idiocy or imbecility.

Disease of the cranial nerves is in the great majority of cases secondary to a diffuse meningitis, but occasionally it is primary, and gummatous neuritis of a single or of several cranial nerves may be found (vide Case 18); or there may be, as in a case recorded by Kahler, a multiple syphilitic neuritis affecting the greater part of the cranial nerves and the spinal roots. I have seen such a case but it was associated with a diffuse cerebro-spinal meningitis (vide pp. 99, 100, Plate XIII). The cranial nerves may also be affected by compression of gummatous tumours, and by aneurysmal dilatation of vessels.

Syphilitic arteritis. I have not seen a case of syphilis of the central nervous system *post mortem* in which the vessels have been perfectly healthy; usually they were extensively diseased, and the majority of the symptoms observed during life, whether indicating general or local loss, or disturbance of function, may be attributed to the disease of the arteries and its effects on the circulation of blood to the central nervous system. The older writers, as already mentioned, described arterial changes in syphilis, and again Sternberg, in 1860, drew attention to the causal relationship of syphilis and arterial disease. A little later Allbutt described the microscopic changes in syphilitic arteries. But it was Heubner's classical monograph in 1874, which showed that endarteritis syphilitica was of overwhelming importance in brain syphilis and in the explanation of its symptomatology. He divided syphilitic vascular affections into three groups:

(i) The arterial disease as the result of an extension of a

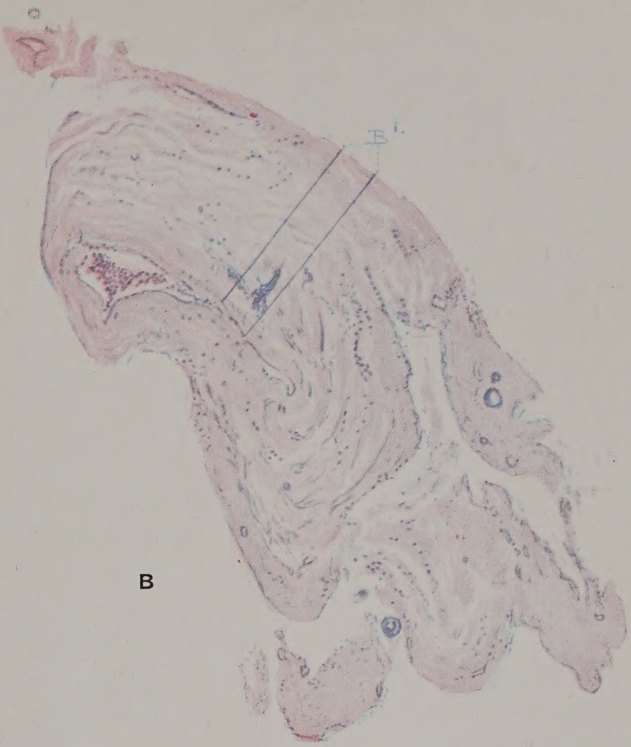
PLATE VI.

A. Section of a branch of the middle cerebral artery, showing obliterative endarteritis, stained with Van Gieson's stain. There is an enormous thickening of the endarterium (*en*), and a formation of new vessels. The elastic fenestrated membrane (*e*) can be seen stained a deep red ; all within this is the thickened endarterium (*en*), which is nearly three times as thick as (*m*) the rest of the arterial wall. Magnification 50 diameters. This section may be seen more highly magnified in Plate VII, A.

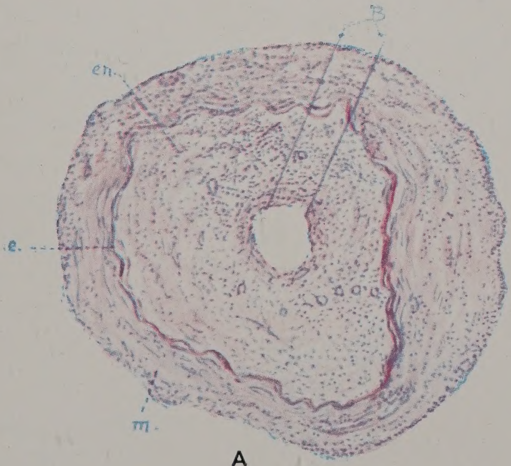
B. A section of the middle cerebral artery, showing the coat of the artery converted into sclerosing fibrous tissue, and (*B′*) the lumen almost obliterated. This section may be seen, more highly magnified, in Plate VII, B.

To face p. 44.]

PLATE VI.



B



A

syphilitic gummatous process to the wall of the vessel, thereby causing damage by compression, or by extension of the process to the wall of the vessel.

(ii) The arterial disease existing independently of, but associated with a syphilitic neoplastic formation.

(iii) The arterial disease existing independently of gummatous meningitis.

The naked-eye change is very characteristic, the arteries, instead of being thin and transparent and collapsing between the fingers and thumb, are firm, cylindrical and cannot be compressed into a flat condition. They may have a greyish yellow appearance like dirty wash-leather, but usually they are not uniformly so; sometimes branches or parts of an artery appear yellow or dirty white; or greyish yellow nodules gradually fading off into greyish pink are seen scattered on the main arterial trunks or their larger branches. Upon transverse section the whole wall may be firm and it cuts readily, showing the lumen partially or nearly wholly obliterated by the thickened wall. In the smaller arteries the lumen is usually uniformly obliterated; in the larger arteries the wall may present a nodular thickening, so that when cut transversely, the thickened uncollapsable portion of the arterial wall has a half-moon shape, and a greyish yellow colour. The vessels about the base are particularly liable to show this endarteritis, and all the vessels of the circle of Willis may be more or less affected and the branches of the same likewise, so that there may be a universal endarteritis (vide Cases 18 and 19, pp. 100–3). Microscopic examination shows that this thickening of the arterial wall is due to a cell hyperplasia in the non-vascular layer which lies between the lining endothelium of the vessel and the fenestrated membrane (vide Plates VI and VII, Figs. A).

Heubner asserted that the syphilitic virus brings about a primary irritation of the endothelium; the overgrowth of this vascular endothelium is the starting-point of the whole process, and this extends to the *vasa vasorum* in the media. It is hardly profitable to give the long discussion between such able pathologists as Baumgarten, Cornil and Ranvier, Friedländer and Köster, who did not accept Heubner's interpretation of the process or his views that the process was specific.

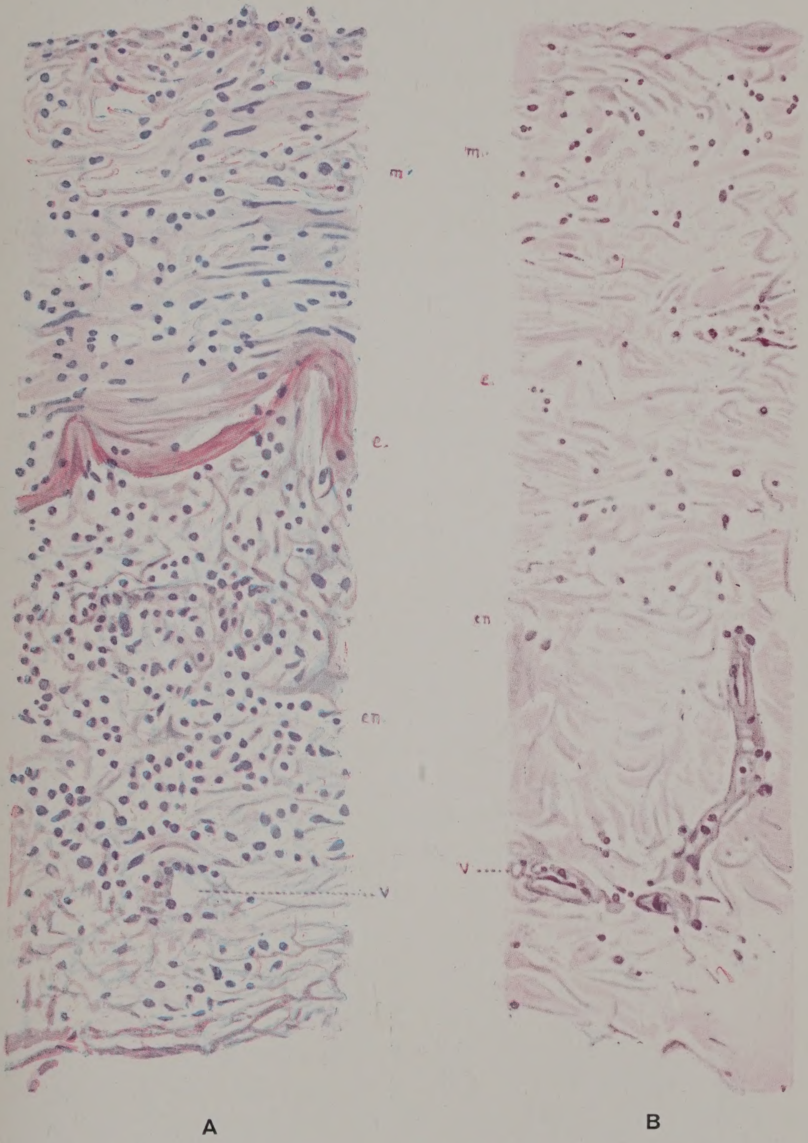
Let us examine the facts in the light of our present knowledge. First of all, it may be asserted that this proliferation of the intima is not specific, although probably in no other disease or condition does it occur in so marked and generalised a form as in syphilis. An endarteritis may occur from ligature of an artery; and from experimental irritation of the adventitia by the application of caustic substances a nodular endarteritis may occur, associated with periarteritis and mesarteritis. The endarteritis of tubercle in no way differs from the endarteritis of syphilis as regards the tissue cell reaction. Is it proliferation of the endothelium lining the vessel? If we had any proof that the syphilitic virus was in the blood we might conceive that Heubner's view that the process began here and spread outwards was correct; but if it be so, why do not the endothelial cells of the arterioles, venules, and capillaries undergo proliferation, and why is the process limited to the arteries with a perivascular lymphatic sheath? There is much more evidence to show that the virus is contained in the perivascular lymphatics and the lymphatics surrounding the *vasa vasorum* rather than in the blood. We therefore might explain this thickening of the intima as a defensive reaction. If we examine a number of vessels in section from the same case we may find totally different appearances presented, in one, we shall find the intima greatly thickened and the lumen almost obliterated, and the adventitia, media and intima infiltrated with lymphocytes and endothelial cells. If there are *vasa vasorum*, and these we should see in a large artery, especially in the neighbourhood of a nodular endarteritis, then around these vessels we should find lymphocytes and plasma cells; the former may have migrated from the blood stream of the vasa, but according to my view they are derived from the connective tissue cell nuclei, as the endothelial cells are from the lymphatic endothelium. I see no reason for departing from the generally expressed principle that the thickening of the inner coat is due to a proliferation of the fixed connective tissue elements. Heubner asserted that syphilitic arteritis does not end in fatty degeneration or calcifica-

PLATE VII.

A. Under a high power a portion of the wall of the vessel seen in Plate VI, A, shows, from without inwards, the muscular coat (*m′*) and adventitia infiltrated with young cells ; next, (*e*) the deeply-stained red elastic lamina ; and, within this, (*en*) the greatly thickened endarterium, infiltrated with cells and showing (*v*) vascularization. Magnification 225 diameters.

B. A portion of the wall of the vessel seen in Plate VI, B, under a higher power, showing the wall of the artery converted into dense coarse fibres, a sclerosing process like that which occurs in the gumma having taken place. The inner surface has become vascularized by the eruption of capillaries (*v*) from the media through (*e*) the fenestrated membrane. The muscular fibres (*m*) can no longer be differentiated. Magnification 225 diameters.

PLATE VII.


m'
e.
cn
v
m.
e.
cn
v
A
B

tion, and therefore does not cause atheroma ; it tends to fibrosis, and this inner coat may become vascularized by the eruption of capillaries from the media through the fenestrated membrane (vide Plates VI, Fig. B ; and VII, Fig. B). Now it will be found that the whole coat of the artery (a large branch of the middle cerebral) has become converted into sclerosing fibrous tissue ; in other regions there are active gummatous formations occurring and even recent endarteritis, but the walls of this particular artery are converted into dense coarse fibres, a sclerosing process like that which occurs in the gumma having taken place.

The virus which causes the endarteritis doubtless is conveyed to the vessels by the lymphatic sheath of the adventitia, and when the vessels *alone* are affected the virus is not free in the cerebro-spinal fluid. This poisoned lymph may be coming from without the cranial cavity, perhaps from one side of the neck or from both, and it will set up a formative hyperplasia sufficient to interfere with the nutrition of the muscular coat and the vaso-motor nerves. Even though the vessels are surrounded with cerebro-spinal fluid, yet at each pulsation the normal pressure in the arteries is greater than the external intracranial pressure, and as the media becomes weaker the intra-arterial pressure would tend more and more to distension, if there were not compensatory thickening of the intima. If the virus in the blood excites the endothelial proliferation, why does it do so in the arteries and not in the veins and smaller vessels ? We can explain the thickening of the inner coat in the form of a nodular patch, by supposing that the muscular coat is damaged at that particular spot by the blocking of the *vasa vasorum.* Is the change in the *vasa vasorum* inflammatory, and due to the action of the specific virus within the nutrient vessels or in the perivascular lymph spaces around ? It is possible to suppose that the spirochaetes may get lodged in the *vasa vasorum* as in the vessels of a papular syphilide, but there is no proof ; in fact, as far as I am aware, no one but Benda has been able to demonstrate the spirochaetes in the vessel wall in cerebral syphilis.

We now leave these speculations as to the mode in which the virus produces the changes in the *vasa vasorum*, which lead to a weakening of a particular area of the vessel, and consider next what the effects of that weakening may be; it will tend to produce a dilatation on one side which will probably cause a rupture of the elastic coat. Now if the weakening of the middle coat is brought about rapidly by an intense inflammation, an aneurysmal dilatation will be formed (vide Case 21, pp. 106, 107). But if the inflammation is less intense and gradual, then the connective tissue cells of the intima lying between the endothelial lining and the elastic lamina will proliferate proportionally to fill up the bulge; in this way we see that the thickening of the intima which we regard as the disease is the best the tissues can do to repair the damage done to the vessel wall by the virus. But, although the thickening protects the nervous tissues against the danger of aneurysm and rupture, new sources of danger arise in proportion to the number of arteries affected, and the rapidity of extension of the process to the arteries forming the circle of Willis and its many branches. Heubner has shown that if two important arteries entering into the circle of Willis are affected, cerebral symptoms arise. The formative proliferation may be excessive and lead to almost complete occlusion of the lumen; still it is astonishing what an amount of obliterative endarteritis may occur without the production of paralytic symptoms or interference with the functions of organic life, provided that thrombosis does not occur. If a spreading thrombus forms in an artery softening of the area supplied by the artery occurs, provided collateral circulation is not established; such is the case with the terminal arteries that supply the internal capsule, the basal ganglia and the arteries which enter the cerebral peduncles, pons and medulla to supply the important afferent and efferent tracts, and the nuclei of the cranial nerves from the third to the twelfth inclusive. Each nucleus—and in the case of the third the several different portions of the nucleus—(vide Fig. 4, p. 69) receives a separate artery, a fact of considerable importance in explaining the symptomatology of syphilitic disease of the arteries. Not only may symptoms arise from local occlusion, but general symptoms due to cerebral anaemia, and especially cortical anaemia arise, owing to the effect of the morbid process interfering with the normal vaso-motorial influence on the cerebral vessels.

Sometimes it appears as if the elastic coat had undergone a duplication or developed several layers; in my opinion what really happens is:—the connective tissue cell proliferation splits the elastic lamina into several layers, which are permanently separated by organization of the new cellular formation. In some cases where the cell proliferation is intense, capillary branches of the *vasa vasorum* grow in from the tunica media (vide Figs. A, Plates VI and VII), and form new vessels in the thickened endarterium. These may lead to new channels in the vessel. If we study the microscopic appearance of the arteries first attacked and compare them with arteries more recently affected (vide Figs. B, Plates VI and VII), we observe a marked difference. The former still show a partial or complete obliteration of the lumen, but the inflammatory process has altered the histological appearances of the media as well as of the intima; the muscle fibres of the middle coat with their deeply staining nuclei can no longer be differentiated; the fibres present a homogeneous staining duller in appearance than the normal, very often the whole wall has much the same appearance throughout. It has the appearance of dense coarse fibrous tissue with spaces between the fibres (vide Fig. B, Plate VII). This fibrous sclerosis is the usual terminal stage of syphilitic endarteritis, and according to Heubner it never ends in atheroma; but I am of opinion that this is too exclusive, and the researches of Oedmannson confirmed by Birch-Hirschfeld upon the atheromatous changes in the umbilical vessels and in the arteries of premature foetuses (stillborn owing to syphilitic infection from the parents) support the contention that atheroma has a direct relation to the syphilitic poison. My experience shows that arterio-sclerosis is found with unusual frequency in young persons, the subjects of syphilitic infection. The frequent association of aneurysm with syphilis and of aneurysm and aortic insufficiency with tabes, has been emphasized by such authorities as Strümpell and Lesser (vide p. 414). We are unable to assert that either the localisation or the extent of the arterio-sclerosis is a proof of its syphilitic origin, but we can assert that the syphilitic virus may lessen the durability of the vessel wall by a devitalizing effect on the muscle fibres, thus diminishing the resistance of this tissue to injury from other causes, such as induce constant increase of the arterial pressure.

The nodular form of the disease must, however, be related to some local interference with the nutrition of the arterial wall by the *vasa vasorum.* Oppenheim calls attention to the fact that occasionally foci of inflammation and softening are found which cannot be associated with arteritis or a new formation. The observations of Virchow, Charcot and Gombault, Gowers. and others show that these patches of encephalitis may occur simultaneously at several spots, and can even spread themselves in a disseminated manner over the whole central nervous system. This *encephalitis* may proceed to softening or sclerosis. The sclerotic processes are particularly to be found in congenital syphilis. Gowers has described a case of miliary degeneration of the cerebral cortex in a syphilitic. Jürgens demonstrated a brain some years ago in which inflammatory softening extended through the whole of a hemisphere with intact vessels ; and he speaks of a universal interstitial encephalitis. I have recently seen a case of progressive pseudo-bulbar paralysis in a young woman, the subject of syphilis; at the autopsy multiple patches of softening were found in the basal ganglia, anterior limb and genu of the internal capsule on both sides. I could not find arterial thrombosis of the lenticulo-striate arteries to account for these caseous looking patches, which varied in size from a hemp seed to a large bean. As in Oppenheim's case they had a yellowish appearance and granular surface on section. Examination of several sections showed a destruction of the nervous material leaving a meshwork of glia fibrils and branching connective tissue cells, in the meshes of which were large numbers of plasma cells and lymphocytes ; the former were especially abundant and appeared to arise from a proliferation of the endothelial cells of the perivascular lymphatics. There were no giant cells and no evidence of tubercle.

Hydrocephalus is extremely rare in acquired syphilis, but it has often been observed in the hereditary form.

All the pathological conditions which have been previously described as occurring in acquired syphilis may occur in congenital syphilis, viz. gummatous tumours, gummatous meningitis, endarteritis, gummatous neuritis, encephalomalacia and encephalitis.

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CHAPTER III

GENERAL SYMPTOMATOLOGY OF BRAIN SYPHILIS

As we have already seen in the section on Pathology the lesions produced by the syphilitic virus naturally fall under three groups :—

1. Affection of the meninges,
2. Affection of the arteries, and
3. The existence of new growths.

In the great majority of cases of severe brain syphilis, according to my experience, the three conditions are combined; especially is this found to be the case in patients who have died in the asylums. There is nothing actually specific about the symptomatology of brain syphilis, and yet, just as in the consideration of the pathological conditions, there is a general grouping of phenomena which make it almost certainly characteristic, so also in the symptomatology ; and a correct understanding of this is of extreme importance, for many cases, if recognized early and placed under suitable treatment, may be saved from a fatal termination, or from becoming mental and physical wrecks. We have seen that the syphilitic process may be observed advancing in one direction while undergoing resorption and resolution in another. We are not surprised therefore to find that one of the characteristics of the disease is the appearance of symptoms of irritation or loss of function, followed by their disappearance ; then, for no apparent reason, a reappearance of the same symptoms or of new ones. This ebb and flow of symptoms is largely due to circulatory disturbances of the brain as a whole, or, as we shall see, of structures with special functions, and the restoration of the circulation by collateral supply or by readjustment. These transitory disturbances, if combined with persistent headache, are particularly significant ; and when occurring in a young adult, and even when there is no history of venereal infection, it would make one consider its probability.

It is a characteristic of brain syphilis to resemble in its symptom-complex a number of serious organic diseases of the nervous system, and yet not be identical with them. Even the same case may resemble a number of these diseases at different periods in its progress, and I have seen competent authorities make very different diagnoses of such cases owing to this variability. Thus at one time a patient may present the signs of meningitis; but, owing to the fact that the arteries may be affected or that there may be an associated intracranial tumour formation, the symptoms are akin to cerebral softening, meningitis, or tumour.

The same case may present at one time, as I have often seen, the clinical picture of epilepsy, of meningitis, of intracranial tumour, of general paresis, or of a dementia with organic brain disease and paralysis (vide Case 19, p. 101).

The kaleidoscopic characters manifested by a severe and fatal case of syphilitic brain disease can be well understood if a complete macroscopic and microscopic examination of the brain be made. The examination I have made of 50 such cases dying in the asylums shows meningitis, arteritis, softenings, and gummatous tumours scattered in the central nervous system in various stages of evolution and devolution.

Group I divides itself into (*a*) Basic Meningitis and (*b*) Meningitis of the Convexity.

(*a*) *Basic Meningitis.* Obviously, the important anatomical structures existing at the base of the brain must have an important relationship to the symptom-complex met with in this form of brain syphilis. First of all, there is the circle of Willis, which, in any meningitic affection, apart even from endarteritis, is certain to be affected to some degree by a peri-arteritis which will extend along the perivascular sheaths into the whole of the important structures forming the base of the brain; the basal ganglia, the internal capsule, the peduncles and pons and medulla, with their important cranial nerve nuclei. Again, all the cranial nerves including the olfactory and especially the optic nerves, chiasma, and tract are liable to be involved in the diffuse gummatous formation, or to be the seat of gummatous tumours. We have seen that the virus is metastatic and attacks at random the structures; consequently, although there is a general similarity in all cases of basic meningitis, and especially as regards certain symptoms, yet there are infinite possibilities of variation in different cases, and even variability in the clinical picture manifested by the same case at different periods of the disease.

Symptoms. Headache is one of the commonest, one of the earliest, and one of the most constant symptoms met with; in fact it is very rarely absent. It may precede all other symptoms by weeks, months, or years. The pain is paroxysmal, and when it reaches its greatest intensity may be boring, splitting, stabbing, or throbbing; but this may die down in the intervals, leaving only a dull aching sensation. The patient wears an anxious pained expression (vide p. 59). I have known the pain so severe as to lead to a patient saying that 'her head was on fire'; this statement occurred in the certification order as a delusion, but I venture to say that the condition found post mortem of multiple gummata and osteitis of the calvarium showed that the patient had correctly interpreted her feelings; the vomiting and optic neuritis associated with the mental symptoms she undoubtedly had should have led to a correct diagnosis and proper treatment.

The severe pain causes sleeplessness, loss of appetite and general failure of health. In basic meningitis there is no tenderness at any particular spot on pressure or percussion as there is in meningitis of the convexity (vide p. 82). When, however, the fifth nerve or the Gasserian ganglion is involved there may be a general hyperaesthesia in the area of distribution of the nerve, and the condition may be diagnosed as trigeminal neuralgia. A case came under my care not long since of this nature.

CASE 4. 'A young woman was admitted to Charing Cross Hospital, married, no children, suffering with severe headache, cachexia, and pigmentation of the neck; there were no other signs of syphilis. There was hyperaesthesia over the whole distribution of the fifth, but especially of the first divisions. She had, besides, vomiting, headache, and double optic neuritis (with four dioptres swelling), and some stiffness in the neck. She had a number of decayed stumps in both jaws; these were removed. She did not begin to improve until she was put on mercurial inunction and iodide; then in a fortnight her general health improved, the headache and vomiting ceased, and the swelling of the disks as reported by Mr. Treacher Collins diminished to two dioptrès. She was discharged subsequently practically well.'

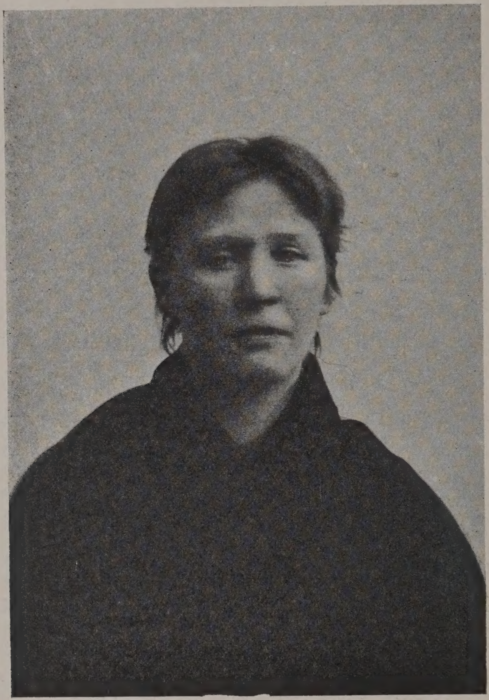

Fig. 1. A case of pseudo-general paralysis in a young woman, age 24. Appearance on admission, dull and stuporose indicating much mental confusion.

In the basic form of the disease the pain is usually referred to the frontal, parietal, and temporal regions, and is deep-seated and cannot be definitely localised; later on it may spread to the occipital region, the neck and the spine; sometimes pain is referred to the back of the eye. In this form of the disease the pain is not usually influenced by pressure and there is not the definite local tenderness which occurs when the convexity is affected.

Vertigo, reeling, and staggering are common symptoms. Doubtless some of the attacks of giddiness from which such patients suffer are disturbances of consciousness; and slight fainting attacks due to circulatory disturbances of the brain from the associated arterial affection. These attacks may be compared with attacks of petit mal or migraine.

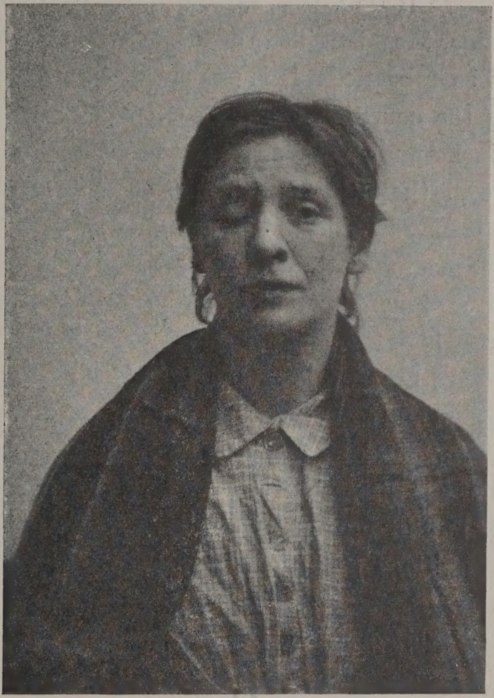

Fig. 2. The same case. Appearance later as the disease progressed, showing marked expression of pain with paralysis of the right motor oculi. She was called a case of General Paralysis in the asylum, but at the post mortem multiple gummata were found in the brain.

Vomiting is a pretty constant symptom, and, together with headache, may for months form the only signs of cerebral disease; it occurs without (necessarily) food in the stomach. Oppenheim relates a case where for months it preceded headache and other symptoms; in this case there was a widespread gummatous meningitis in the posterior cerebral fossa. Cases have been recorded, however, and I have myself seen such, where vomiting was absent throughout the whole course of the disease to the fatal termination.

Body Temperature. There is a considerable difference of opinion by authorities as to the existence of *pyrexia* as a result of syphilitic basic meningitis. Fever may occur at the onset of symptoms in some cases, but as a rule it is not high (perhaps one or two degrees above the normal) and it does not persist according to my experience (vide Cases 11 to 18, pp. 80–100). When we come to consider the possibilities of secondary microbial infections occurring as complications, it is not surprising that fever should occur during the course of the disease ; one of the most fruitful causes is broncho-pneumonia owing to the entrance of food into the air passages while the patient is in a semi-conscious state. With these reservations it may be said that it is pretty generally recognized that syphilitic meningitis differs from, e.g. tubercular and pyogenic microbial forms of meningitis by the absence of pyrexia. Heubner states that very high fever may occur, and I have seen this happen when there have been prolonged convulsions. The temperature is usually normal and sometimes subnormal. If pyrexia is present it is of an anomalous form ; it may be remittent and sometimes, at the onset of the disease, there may be a rise of temperature in the evening, but in my experience pyrexia is unusual (except under the conditions previously mentioned) in syphilitic brain diseases.

Psychical Disturbances. No symptoms play a more important rôle in the symptomatology of brain syphilis, especially the basic form of the disease, than the disturbances of consciousness. Combined with stupor—which is met with in many cases of brain tumour—are manifold other disturbances of consciousness.

A very characteristic sign of basic syphilitic meningitis is the semi-somnolent, semi-conscious, semi-comatose condition, in which the mental functions are more or less obfuscated rather than obliterated. The patients may present a lethargic, typhoid, or semi-intoxicated condition from which they can be temporarily roused—a condition which is, however, frequently combined with a purposeless, hazy motor delirium, not of a purely automatic character. Even in the lesser degrees of obnubilation of consciousness, there are certain criteria of especial significance ; thus a patient may be roused to more or less correctly answer questions in a slow, drawling, dreamy, sleepy manner. He may even perform complex acts in response to requests or demands, yet be unable to respond to the calls of nature, and he passes urine and faeces in the bed, or evacuates his excreta in the room. Occasionally, the patient may shamelessly masturbate. The mind may again become clear and he may regain control, but not infrequently this loss of control over the sphincters persists, and this denotes usually a permanent state of dementia. The dementia of syphilitic brain disease is characterized by being partial and recurring in attacks ; it does not alter the character and personality of the individual to the same extent as in the dementia of general paresis. He preserves his autocritical faculties and is conscious of his intellectual deficit, and he is by no means indifferent to his mental and bodily condition. He may suffer with loss of memory, especially of recent events, and his knowledge of time and place may be defective. He is subject to sudden fits of excitation with motor restlessness or of depression with suicidal tendencies.

In some cases, consciousness remains for a long time undisturbed ; then the patient may suddenly become comatose and die.

Cases recorded by Buzzard, Althaus, Rumpf, and Fournier, show that coma may be the sole symptom of a fatal cerebral syphilis. But a deep coma may, on the other hand, disappear, and the patient become semi-conscious or even completely recover consciousness. Another noteworthy phenomenon is a drowsy condition which may deepen into a semi-conscious state from which he can be awakened only to return to a state of deep comatose lethargy. The patient is not really comatose, as the muscles are not flaccid and the reflexes are not abolished, but a strong stimulus is required to produce a reaction ; spontaneous reaction there is none. I have seen many such cases and they strongly remind me of the condition met with in the later stages of the cases of sleeping sickness (negro lethargy), which I have seen. But what is of even greater interest in this respect is the similarity of the pathological lesion, viz. in both diseases there is an intense meningo-encephalitis characterized by an infiltration of the meningeal and perivascular lymphatics with lymphocytes and plasma cells (vide Figs. 4 and 5, Plate II). There is, however, never endarteritis or tumour formation in sleeping sickness. The sleepy, drowsy condition and absence of spontaneous initiative in both diseases is due to cerebral anaemia. Even when the patient under the influence of treatment recovers consciousness, so that hopes of permanent cure arise, nevertheless the fact that he has suffered with these drowsy stuporose conditions is an evil omen, as they indicate widespread disease; moreover, another danger is that mercurial stomatitis may ensue and, as the patient is unable to gargle or clear the mouth of saliva, he is liable to choke. A case recently occurred in my practice at Charing Cross Hospital, which illustrates the point.

Case 5. A man, aged 33, was admitted in a stuporose condition from which he could be aroused; there was a history of syphilis and old post-neuritic atrophy marked on the left side. He suffered with occasional attacks of vomiting and headache, and periods of drowsy stupor from which he would awake to a fair state of consciousness, sufficient to answer questions and respond by simple acts to requests. There was, however, mental weakness and confusion and some loss of memory. Even while in the conscious state he did not control the calls of nature and passed urine and faeces in bed. He improved so much that I had hopes of discharging him when he developed a mercurial stomatitis and, lapsing into a drowsy unconscious state, died of asphyxia. Syphilitic meningitis and a gummatous mass were found at the base of the brain. Also some foreign matter was found in the right bronchus.

All gradations of loss of intelligence, weakness of mind and of memory are to be met with in these cases; but during the course of the disease, marked oscillations and remissions of the mental disorder may occur. Patients are frequently sent to the asylums who have been taken up by the police, found wandering at large, or because they have committed acts dangerous to themselves or others. They may have delusions and hallucinations, which, when combined with motor restlessness and tremor, alternating possibly with a semi-intoxicated drowsy stupor, present a clinical picture not unlike delirium tremens. Again, they may have delusions of being followed, or of persecution or of poisoning, which may incite them to acts of violence. Seeing that drink is often associated with the onset of the symptoms, or that the patient is addicted to drink, all the symptoms may be put down to alcoholic intoxication, unless some obtrusive paralytic symptom, viz. an oculo-motor paralysis, makes one suspect an organic brain disease. These insane conditions may alternate with stuporose, semi-comatose attacks, and with various degrees of return to normal states of consciousness in which the intelligence is not seriously impaired.

Convulsive Attacks. General convulsions of an epileptic character, unilateral or partial epileptiform seizures are not infrequent, and I have seen a case in which tetaniform spasm and opisthotonus occurred, but then the meningitis was found post mortem to have affected the posterior fossa and the spinal cord. General tremor is not infrequently met with in the severe fatal cases occurring in asylums.

If recovery from basic syphilitic meningitis occurs, some mental deficiency results, and if there are no coarse obtrusive symptoms pointing to mental decay or destruction of brain substance, yet there is nearly always some slowness of ideation and verbal expression, combined with lack or deficiency of higher control, and distinctly purposeless outbursts of temper, or fits of anger. There is a lack of expression in the physiognomy or a fixity of gaze, suggestive of an enfeebled mind. Moreover, such patients are liable to develop epilepsy, and to them even small quantities of alcohol may act as a poison.

Polydipsia and Polyuria. Sometimes excessive thirst and the passage of large quantities of pale urine of low specific gravity may be a pronounced symptom during the whole course of the disease ; more often this condition exhibits remissions.

According to Oppenheim, polyuria is a frequent symptom. I have not observed it often, but in asylum cases such a condition might have been overlooked. It has been ascribed by some authorities to an affection of the vasomotor centre in the floor of the fourth ventricle, by others to an affection of the vagus.

Diabetes Mellitus is occasionally met with. When dementia occurs there may be a voracious appetite independently of glycosuria. Sometimes the patient steals his neighbour's food; a symptom which the attendants in asylums regard as very characteristic of general paresis.

Eye Symptoms. In describing the pathology of the disease it has been pointed out that the optic chiasma and interpeduncular space are sites of predilection for gummatous tumours and the diffuse gummatous meningitis; consequently visual troubles of all kinds up to complete blindness and partial or complete oculo-motor paralysis are among the commonest symptoms in this form of brain syphilis. The observations of early authors on brain syphilis showed how frequently affections of the cranial nerves and motor and sensory tracts occur; the nerves supplying the muscles of the eyeball are especially liable to be affected. Von Graefe, in 160 cases, found that in more than one-half there was some form of oculo-motor paralysis. Alexander found that in 727 cases there was unilateral paralysis partial or complete of the oculo-motor nerve, and both Ricord and Fournier designate this ophthalmoplegia 'la signature de la vérole'. The important significance of eye affections in cerebral syphilis is strikingly emphasized by Uhtoff's observations; for he found that only in about 15 per cent. of all cases of cerebral syphilis were eye affections completely absent during the whole course of the disease. Oppenheim is able to confirm the truth of this statement, as he had the opportunity of examining a large proportion of the cases.

Brain syphilis may be accompanied by the following ophthalmoscopic changes:—

(1) Optic neuritis.
(2) Choked disk.
(3) Neuritic atrophy.
(4) Simple atrophy.

In the greater number of cases of cerebral syphilis these conditions are associated with a basic meningitis. Choked disk, when present, almost always affects both eyes, whilst neuritis may remain limited to one eye. The former condition is due to tumour formations which may be situated anywhere in the cranial cavity; consequently, the general increase of intracranial pressure caused by their presence affects both eyes pretty equally. Neuritis is, however, due to the extension of the gummatous inflammation, first to the sheath, and then to the optic nerve itself. It is often limited to one side during the whole course of the disease, and when both are affected there is generally, in contradistinction to the choked disk, a very considerable difference in the intensity of the neuritis in the two eyes. Owing to the external situation of the macular bundle of fibres a central scotoma may arise as a consequence of a gummatous process setting up a retrobulbar neuritis of these fibres.

If the gummatous process (meningitis) extends primarily to the optic chiasma and optic tracts, considerable visual disturbances may occur without any observable changes in the fundus. We thus see how it is not only necessary to make an examination with the ophthalmoscope, but to test the fields of vision with the perimeter, and to chart the results if the patient is in a fit condition for the examination. According to the experience of Oppenheim and others, hemianopsy is fairly frequently met with; it is generally due to the chiasma of the optic tract being involved. It may arise, however, from softening of the optic radiations caused by arterial thrombosis or from the existence of a large gumma or softening in the occipital lobe.

The disease of the chiasma and optic tract gives, beside recognizable ophthalmoscopic changes, hemianopsy; but the character of the hemianopsy is different when the disease affects the middle of the optic chiasma; because the optic nerve fibres in the chiasma undergo a partial crossing, and when the chiasma is affected bitemporal or binasal hemianopsy may occur; but a homonymous hemianopsy when the optic tract is affected (vide Plate XII).

I have once seen a case of hemianopsy which I believe was due to syphilitic affection of the right optic tract with loss of the left half of the field of vision associated with that very rare condition, Wernicke's pupil reaction; for the nasal side of the retina did not respond to a beam of light directed by a lens on the left side, whereas the temporal half did. Occasionally a homonymous hemianopsy may arise from softening of the optic radiations due to syphilitic arteritis with thrombosis, and I have twice found post mortem a large gumma in the occipital lobe, which from its situation must have produced a hemianopsy which was not observed during life.

In the great majority of cases of severe brain syphilis I have found post mortem the optic chiasma, optic tract, or optic nerves involved by gummatous tumours or by diffuse meningitis. This seems to have also been the experience of other observers. Wilbrand and Säenger relate the case of a man, aged 20, who suffered with severe headache five months after infection ; a month later he became blind in the left eye, and ten days later blind in the right eye. Besides bilateral amaurosis there was oculo-motor paralysis, diminution of the sense of smell, and affection of the fifth nerve on the left side. The patient died eighteen days later, in spite of energetic treatment. The autopsy showed two gummatous growths at the base of the brain, of which one, the larger, lay behind the optic chiasma on the left optic tract ; the other, smaller, was seated more to the right.

A gummatous process at the base of the brain can produce by extension a localised neuritis or perineuritis of the optic nerve fibres, and cause a *neuritis descendens*. Now in the stem of the optic nerve the fibres to the macular region run at the periphery, and a perineuritis will naturally damage the outside fibres first, causing thereby a blurring or scotoma of the central visual field.

On the other hand, when the central parts of the optic nerve are affected, the defect will be most marked in the peripheral field of vision. In most cases where the gummatous process has attacked the nerve, there remains a variable proportion of the optic fibres still functionally intact ; consequently all grades of partial blindness may occur, but, in some cases, the whole of the optic fibres may be destroyed, and the result is complete blindness. It will be easily understood that all possible forms of limitation of the visual field and of central scotoma may arise, and from the foregoing remarks it will be understood why irregularity in the defects of the visual field is a noticeable feature in syphilitic brain disease. This part of the subject will be treated more fully in Vol. V of this System.

Oculo-Motor, Third Nerve. Of all the cranial nerves the oculomotor nerve is by far the most frequently affected ; it may be affected on one side or on both sides, completely or partially, but as a rule, all the muscles supplied by the nerve are not paralysed, The muscle specially liable to be paralysed, also the earliest to be affected, is the levator palpebrae, causing ptosis ; in fact, this condition should always make one think of the possibility of syphilis apart from any other symptom. Sometimes the pupil only is affected ; it is often dilated on one side and fixed to light and accommodation ; sometimes only the light reflex is lost ; and I have seen two cases in which both oculo-motor nerves were completely paralysed.

Case 6. A woman, aged 51, was sent to me by Mr. Treacher Collins, who had, besides paresis in the limbs, ankle clonus, and exaggerated knee-jerks, complete bilateral ophthalmoplegia, externa and interna ; when first seen, she was in a stupid, dazed, somnolent condition ; six weeks' antisyphilitic treatment led to an almost complete recovery. The diagnosis made was gumma in the interpeduncular space involving both third nerves.

Case 7. H. A., aged 37, was infected with syphilis at the age of 33. The nervous symptoms which brought him under observation at St. Bartholomew's Hospital were drowsiness and stupor ; he became insane and was transferred to the City of London Asylum. His mental condition improved considerably with the administration of iodide of potassium in large doses, and he was discharged and sent to see me at Charing Cross Hospital. He had no recollection of his having been in St. Bartholomew's, or what happened there. It may have been in part due to the fact that he was unable to see because his eyes were closed. His mind was now fairly clear and his knowledge of time and place good, likewise his comprehension, and there was little or no evidence of the mental confusion from which he had suffered. He had no affection of smell or taste. There was optic atrophy of both eyes ; the right was cupped, the vessels were normal in size, and the disks pale. Vision was defective in the left eye and almost completely lost in the right. There was partial ptosis of both eyes. The right eye was fixed in an upward and outward position. If he shut the left eye the right eye could be directed straight forward in the normal visual axis by an effort of the will. The left eye was fixed. The pupils were small, equal, and inactive to light, accommodation, or pain; the eyeballs were nearly immobile, except for a slight lateral movement to the left. There was no sensory disturbance. The knee-jerks were exaggerated. No ankle clonus, no extensive plantar reflex. This was probably due to a gummatous process involving both optic nerves and the nerves of the eye-muscles in their course to the orbits.

Oppenheim states that in 17 cases in which autopsies were made, the oculo-motor nerves were affected ten times; in 6 cases bilaterally. In 100 cases he observed clinically the third nerve was affected thirty-four times; the sixth nerve was affected sixteen times, and the fourth nerve five times. We can easily understand why the third nerve is so frequently paralysed by direct involvement in the gummatous material of the nerve or its roots of origin at the side of the crus. But are there any anatomical conditions which will serve to explain why the paralyses are so often only partial?

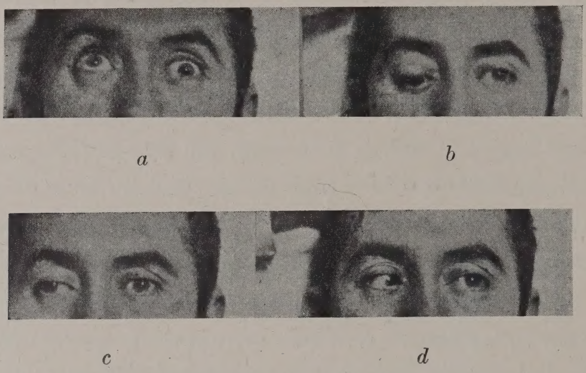

Fig. 3. Paralysis of all the external and internal muscles of the left eyeball. Complete immobility looking upwards (*a*), downwards (*b*), outwards (*c*), and inwards (*d*). It will be noticed that the levator palpebrae has escaped, and reference to Fig. 4 shows that the levator of the upper lid, which so frequently is alone paralysed, is the most anterior group. There is, however, now no ptosis. The patient became blind and subsequently died, and a basic gummatous meningitis was found, with several gummatous tumours about the base of the brain. The patient was admitted to Hanwell, and was looked upon as a case of paralytic dementia.

The accompanying figure shows that the nuclei of origin of these rootlets which together make up the third nerve form a series which extends from the posterior end of the third ventricle behind the anterior corpora quadrigemina to beyond the posterior corpora quadrigemina. The ganglion cells forming these

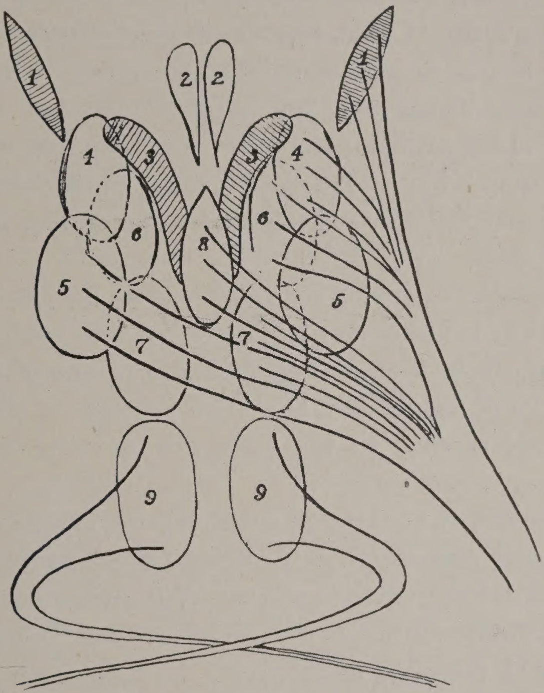

FIG. 4. Schematic diagram of the nuclei of the oculo-motor and trochlear nerves. The constitution of the nucleus is very complicated, and in the main we follow the description of Perlia, *Archiv f. Ophthalmologie*, 35.

We can distinguish an anterior smaller, 1 to 2, and a posterior larger portion, 3 to 8. In the larger nuclear mass is a central group in which ganglion cells from both sides meet beneath the aqueduct of Sylvius–Perlia's central nucleus, 8. There is a lateral division on each side, 4 to 7. It is impossible to follow the whole of the different views with regard to the functions of these groups of cells, but it is generally recognized that the nuclei of the sphincter pupillae and the ciliary muscle lie in front of the others. And it is usually considered that the groups 1, and possibly 3, are connected with the sphincter pupillae and the ciliary muscle. With regard to the principal nuclear mass we may assume that those cell groups 4, 6, 7, which send out nerve-fibres on this same side, direct movements of the eye inwards. That from which fibres pass to the nerve of the other side, 5, directs movements outwards. Group 7 probably is connected with the movements of the inferior rectus, and 4 of the superior rectus, and 5 of the inferior oblique. It is probable that nucleus 2 is connected with the levator palpebrae. 9 is the nucleus of the trochlear nerve.

nuclei are of two kinds, small and large ; the former innervate the internal muscles, the latter the external muscles of the eyeball. It will be observed that there are separate cell groups for each muscle, and that the levator of the upper lid which is so frequently alone paralysed is the most anterior group, the next being the sphincter pupillae. If, then, these nuclei have a separate vascular supply, or if certain groups have a separate vascular supply, we can easily understand how arterial occlusion can bring about a permanent ocular paralysis of one group. Now the third nucleus is supplied by two distinct sources, an anterior from the posterior cerebral artery, and a posterior, direct from the basilar artery.

Those arteries supplying the third nucleus are terminal, that is to say, their branches do not anastomose with others ; consequently we can understand how occlusion of one of these two main arteries of supply may produce a paralysis of the levator of the eyelid sparing all the other extrinsic muscles, or the converse may occur.

Furthermore, if the arteries supplying the groups of nuclei, as they ascend vertically from the ventral to the dorsal side, give off separate arterial twigs to the separate groups of cells from which arise fibres innervating the several muscles, then temporary occlusion and complete blocking will lead to a temporary or permanent paralysis of one muscle. Moreover, the separate course of these root-fibres through the crus cerebri and the upper part of the pons allows of their separate damage and isolated functional disturbance.

Although oculo-motor paralyses are extremely frequent in cerebral syphilis, it is by no means correct to assume that it does not occur in any other conditions. The *transitory paralyses* of ocular muscles, according to my experience, is much more common in tabes than in syphilitic brain disease. Oculo-motor paralyses, as Fournier pointed out, may be a very early symptom. This is of considerable interest, for in London a large number of cases of early syphilitic brain disease and parasyphilis first come under observation at the special eye hospitals. Säenger describes the following case of oculo-motor paresis combined with disease of the olfactory and trigeminal nerves six months after infection. A man, aged 20, five months after syphilitic infection, suffered with severe headache, and one month later his sight became affected, and in the course of twelve days he became blind in the left eye, and ten days later in the right eye. There were also oculo-motor paralysis, diminution of the sense of smell, and paralysis of the left fifth nerve. The patient died, in spite of energetic treatment, very shortly after. The autopsy showed two gummatous growths at the base of the brain. Wilbrand and Säenger relate the history of a case of oculo-motor paralysis twelve weeks after infection, which was cured in the course of eight weeks. Ocular paralyses, however, frequently occur in the later stage of the disease, and

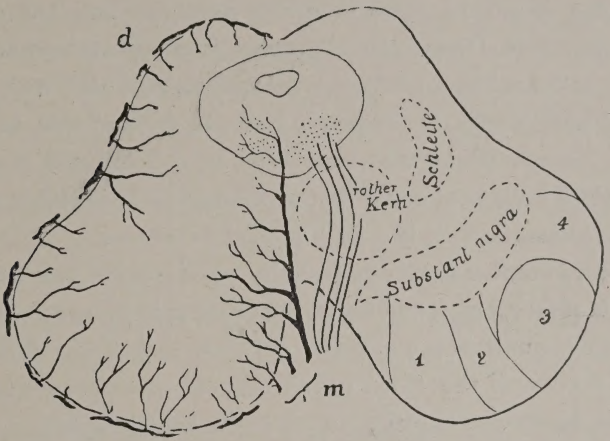

Fig. 5. Diagram of the vascular supply of the crura cerebri and the nuclei round the aqueduct. There are terminal branches of the arterial stem, and each group of nuclei receives a separate arterial branch; consequently obstruction to one of these arteries might lead to a temporary or permanent loss of function of the muscle or muscles innervated by that particular group of neurones. We can thus understand how ocular paralysis of the most varied kind may arise in syphilitic brain disease. If the main arteries are blocked, there will be a complete ophthalmoplegia, interna and externa, as not infrequently occurs in a severe gummatous meningitis about the base of the brain. When, however, there is a partial and scattered endarteritis, the disease may be only sufficient to interfere with the nutrition, or cause the softening of one or more nuclear groups. Again, it will be seen that the nerve in its passage from the nucleus through the crus cerebri may be involved in a process of softening or by a gummatous process. d=dorsal vascular area; l=lateral vascular area; m=median vascular area; 1=cortico pontine fibres from the frontal lobe; 2=pyramidal tract fibres to cranial nerve nuclei; 3=pyramidal tract fibres to spinal nuclei of trunk and limbs; 4=fibres from temporal and occipital lobes.

paralysis of the internal muscles (vide Fig. 3, p. 68), especially of the sphincter pupillae, is a late manifestation of syphilitic infection.

Knies asserts that in three-fourths of the cases of syphilitic eye-muscle paralyses it is the third nerve that is affected. Total oculo-motor paralysis is much rarer than partial paralysis. Alexander found 19 cases of total paralysis and 145 cases of partial paralysis. *Complete* oculo-motor paralysis without any other functional disturbance of the cranial nerves, and only with general cerebral phenomena, is extremely rare; in spite of this, according to Max Nonne, Dinier has succeeded in collecting 8 such cases of complete unilateral oculo-motor paralysis. It is either affected with other nerves or it is only a partial paralysis.

An oculo-motor paralysis (usually complete) of one side, with paralysis of face, arms, and leg of the other side points indubitably either to a gummatous process or to a softening of one crus cerebri involving the third nerve and the pyramidal system of the crus, producing thereby an alternate hemiplegia.

The results of autopsies show that a gummatous mass may involve the stem of the third nerve and only cause either an external or an internal ophthalmoplegia. Cases have been described of perineuritis of single intra-orbital branches of the third nerve. Also a gummatous process in the orbital fissure may cause paralysis of all the external and internal eye-muscles, anaesthesia in the first divisions of the fifth, exophthalmos, and oedema of the upper eyelid (Max Nonne).

The following case is of interest in this respect: W. B., aged 45, admitted to Charing Cross Hospital under my care; history of syphilis twenty-five years previously. Severe headache (at first frontal) began two months ago and extended to the circumocular region. The right eye became prominent, and he suffered with squint and double vision, then severe vomiting. He also complained of frequent micturition, every half-hour during the day and several times during the night. He passed a large amount of water and was correspondingly thirsty.

On admission there was proptosis of the right eye and oedema of the lower eyelid. Pupils—right larger than left, both reacting to light. Movements of the right eye upwards and downwards normal, lateral movement quite lost. Optic neuritis more marked on the right side in both eyes. Blurring of the margin of both disks. Vision 6/6 both sides. There was considerable limitation of the field of vision to white, red, and green in the right eye. Discharged cured, after about six weeks' antisyphilitic treatment.

Affection of the fourth and sixth nerves.—Allusion has already been made to the relative frequency with which these nerves are affected. Uhtoff found the abducens three times affected in 17 of his own post-mortem examinations, and in 150 collected cases he found it in 27, of which 6 only were affected bilaterally ; consequently it is different in this respect from the bilateral disease of the oculo-motor nerve. The causes of affection of the sixth nerve are softening of the pons produced by specific arterital affections, gummatous tumours, basal meningitis, and neuritis. When both nerves were affected there was always an associated basic meningitis.

Intrapontine affection of the abducens is nearly always associated with facial paralysis or contralateral paralysis of the extremities.

Among his 15 cases Uhtoff found only one case of lesion of the fourth nerve ; among 150 collected cases it was affected in six instances ; it was always affected in association with other cranial nerves in a gummatous basic meningitis or neuritis. The paralyses of the eye-muscles are of great interest and importance in relation to brain syphilis, pseudo-tabes, and tabes, and will be further considered in discussing the question of diagnosis.

The fifth nerve. This nerve is affected about as often as the abducens ; for, according to Uhtoff's statistics, the fifth nerve is involved in about 14 per cent. of all cases of brain syphilis. It is very rarely affected alone, only four times in 37 cases. Generally it is associated with affection of the optic nerves or the nerves of the eye-muscles ; the affection is nearly always unilateral, but a few cases have been recorded in which it has been affected on both sides, and Hutchinson has described two such cases. The sensory portion of the nerve is affected much more often than the motor ; in fact, only a very few isolated cases have been recorded of paralysis of the muscles of mastication with atrophy. Gummata about the base of the brain, or gummatous meningitis, or syphilitic disease of the base of the skull may affect the Gasserian ganglion or any or all of the three divisions of the nerve; and obviously a basic meningitis may involve the trunk of nerve-fibres proceeding from the ganglion to the side of the pons. Within the pons, the fibres spread out like a fan to end in the sensory nucleus; consequently softenings from arterial disease may produce lesions of these systems of fibres in conjunction with other structures. The disturbances arising from lesions of the fifth nerve may take the form of irritation phenomena, in one, in several, or in all the branches of the trigeminus, and the patient in consequence complains of neuralgic pains in the forehead, cheeks, temples, eye, upper jaw, lower jaw, tongue, &c. (see Case 4, p. 57). With these pains is associated a hyperaesthesia, corresponding to the distribution of one or more or all of the divisions of the nerve, which sooner or later leads to hypaesthesia, or even a complete anaesthesia. Sometimes there is analgesia or hypalgesia (vide Case 8). The corneal reflex may be abolished, and if the gummatous process involves the Gasserian ganglion or the ophthalmic division a neuro-paralytic keratitis may occur, which in some instances has led to the necessity of enucleation of the eyeball. Anosmia, due to an affection of the mucous membrane of the nose, may follow lesions of this nerve. A loss of taste in the corresponding side of the tongue may occur. Disease of the fifth nerve is often associated with paralysis of the opposite side of the body, but in the following case, which has several points of interest, it was on the same side :—

Case 8. G. H., aged 31, labourer, contracted syphilis and neglected treatment; two years later had a slight fit, followed by numbness and weakness on the right side. He was seen by a doctor and treated for some time with antisyphilitic remedies and sent on to me. He then had weakness of right arm and right leg, slight loss of expression on right side of his face, with paresis of soft palate on right side and of the right vocal cord. He had no paralysis of the muscles of mastication. Tongue deviated slightly to the right.

The most noticeable symptom, however, was in the appearance of the two eyes. At first, one would think there was slight ptosis; there was, however, no paresis of the ocular muscle—the pupils were equal, and reacted to light and accommodation. Comparison with a photograph before the patient's illness shows a condition of enophthalmos of the right eye (vide Fig. 6). The cornea was insensitive, and there was some slight conjunctivitis, which was cured with boracic acid lotion. Pricking was only recognized as a touch all over the distribution of the fifth on the right side, including the mucous membrane of the mouth, lips, and tongue. There was dullness of perception of heat, cold, and touch all over the same area. Taste on the right side of the tongue was impaired. He complained of the stiffness of the muscles of the face on the same side, and the slight loss of expression was due to the anaesthesia. The giddiness, with a tendency to fall to the left side, which he had at first, was passing off. The condition of enophthalmos was probably not due to paresis

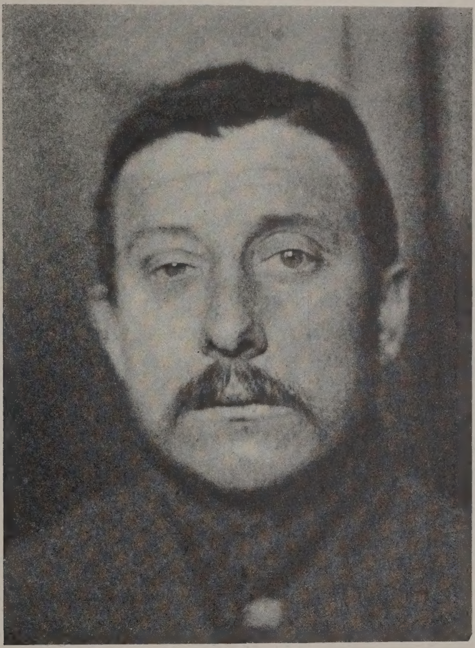

FIG. 6. Photograph of G. H. (Case 8), showing enophthalmos.

of Muller's muscle (which is supplied by the sympathetic), for, acting upon the suggestion of Mr. Nettleship, I found that cocaine dilated the pupil.

Basal gummatous meningitis, syphilitic disease of the ethmoid bone, and gummatous tumour in the frontal lobe may produce *anosmia* on one or both sides from inflammatory extension to, or compression of the olfactory nerve. Very few cases are recorded, but this is probably due to the fact that to test smell in these cases is either difficult or the test has been neglected.

The seventh, facial nerve is affected almost as frequently as the fifth. The acusticus, eighth, is often involved with the facial. They may be affected on one side or both sides. The nuclei and roots of origin of these nerves may be affected as well as any part of their course, from the base of the brain to their exit from the skull. There may result peripheral facial paralysis or deafness, or the two may be combined. These paralyses may arise in any of the stages of syphilis, but they occur most frequently in the earlier periods after infection; their pathology is not always identical; they may be associated with tertiary lesions, gumma of the nerves, exostosis of the internal ear, basic meningitis, neuritis, or perineuritis. The prognosis for hearing is unfavourable; as a general rule the facial paralysis is transitory, but the deafness is irremediable.

The facial nerve may also be affected in conjunction with other structures in the pons; thus it may be involved in a gumma, or, as more frequently happens, in softening from endarteritis. Frequently an alternate paralysis occurs (vide Case 18, p. 99), very characteristic, from the fact that there is a complete facial paralysis on one side—owing to the involvement of the nucleus or its root of origin—causing inability to close the eye, and paralysis of the upper as well as the lower part of the face, associated with electrical changes and reaction of degeneration, corresponding therefore with a peripheral facial-nerve paralysis. Associated with this is a paralysis of the opposite arm and leg, due to the pyramidal fibres being involved in the lesion before they have decussated at the pyramids. Peripheral facial paralysis is said to occur in the second stage of syphilis, owing to the liability to inflammation from cold and other causes; but it is probable that, in the majority of cases, it is coincidence rather than cause.

It is necessary here to remark that a transitory facial paralysis of a peripheral character has been described in the initial stages of tabes.

The eighth nerve, acusticus, as before said, may be involved in conjunction with the facial, but it may be affected alone. Again, the internal auditory may be affected separately from the external auditory, so that in the former case deafness partial or complete, or disturbances of hearing, may arise in consequence; or if the external auditory be affected, symptoms of Menière's disease may appear. Syphilitic bone-disease is also a cause of facial paralysis and deafness with giddiness. Isolated paralyses of the glosso-pharyngeal or ninth nerve have not been observed, but the vagus nerve and its nucleus may be affected, and the symptoms noted have been mainly disturbances of the circulation and respiration. Especially characteristic is a rapid change of the pulse; it may be slow, quick, or irregular; again, various respiratory disturbances towards the end of life are referred to affections of this nerve. The spinal accessory, either alone or associated with the hypoglossal, is not infrequently affected. I have had a number of cases sent from the throat hospital with paralysis or paresis of the vocal cords and of the soft palate, associated with a hemiplegia in some instances. In one case eight years after infection, paralysis of the spinal accessory and hypoglossal nerves of the right side, causing unilateral paralysis of the soft palate and vocal cord with paralysis and atrophy of the right half of the tongue was found, but there was no paralysis of the sterno-mastoid or trapezius. Nor was there any paralysis of the limbs. An improvement took place under treatment, but I cannot say whether it was caused by a meningitis involving the nerves or an endarteritis damaging the nuclei of the nerves. Pachymeningitis of the posterior fossae of the skull may cause constriction or compression of the medulla oblongata and of the nerves arising from it, causing aphonia, paralysis of swallowing and respiration, with tachycardia and hemiatrophy of the tongue. Such a case was observed during life and post-mortem by Oppenheim. In another case in which were hoarseness, spasmodic cough, and vomiting, paresis of soft palate, paralysis of right vocal cord, paralysis of the trapezius and sterno-mastoid with partial reaction of degeneration, there was found a diffuse spreading meningitis extending to the spinal cord, as well as atrophy of the solitary bundle of the nuclei of the vagus and glosso-pharyngeal nerves. We can thus readily understand how a gumma or a gummatous meningitis of the posterior fossa may involve the important nerves arising from the bulb.

Cases of Syphilitic Brain Disease

Case 9. W. R., aged 27, admitted to Hanwell Asylum, October 13, 1894. Medical certificate: 'He was brought as a "lunatic wandering at large"; he behaves in a very strange manner, talks incoherently to himself; when asked questions he only remarks "Thank you, sir", or "Good morning". He shouts, is restless, and beyond control.'

Abstract of notes. He was treated at the North-West London Hospital by Drs. Beevor and Galloway, from whom I obtained the following information. He contracted syphilis in February, 1893; suffered with partial left hemiplegia, end of September, 1893. In February, 1899, he had two attacks of transitory aphasia, with numbness and tingling in the limbs, chiefly in the right hand, but in the hands more than in the legs. Two months previously he seems to have had a transitory paralysis of the right leg; in April, the vision of the right eye was affected, and he became almost completely blind; there was no optic neuritis. In August he had epileptic fits, and later distinct swelling and neuritis were observed in both eyes, especially in the right.

Condition on admission. Scars of syphilitic ulceration on various parts of the body; he is in a drowsy stuporose condition, complains of great pains in the head; there is ptosis of the right eyelid, and he is almost blind in the right eye; there is marked tremor of the tongue and face muscles; the dementia increased and he became bedridden; after several transient attacks of paralysis, he became completely paralysed on the left side. Later, paralysis became bilateral and coma supervened, from which he died twenty months after the onset. This patient was treated with mercury and iodide of potassium, but not very efficiently.

Post-mortem examination. There is a large projection on the vertex of the skull; on removal of the skull-cap, this was seen to be connected with the dura-mater, and with a large gummatous mass situated at the top of the central convolutions of the right side, about the size of a hen's egg; this gummatous mass had apparently commenced in the membranes, grown downwards into the brain and upwards through the skull. The meninges were thickened and adherent for some considerable area around. On removing the brain, gummatous masses were found in various situations; one large mass involved the anterior part of the left temporal lobe, filled up the adjoining Sylvian fissure, and extended into Broca's convolution; another gummatous mass involved the left optic tract; the whole base of the brain was covered with a diffuse gelatinous, greyish-white, gummatous deposit; moreover, patches of softening were found in the internal capsule on both sides, and in the crura cerebri; there was a general endarteritis and periarteritis of the vessels confirmed by microscopic examination; many of the branches of the circle of Willis, especially in the Sylvian fissure, were surrounded and involved by the gummatous mass; examination showed complete destruction of the muscular coat by the infiltrations, the crinkled elastic coat being the only means of recognizing in some sections the existence of the artery. In sections a little further removed from the gummatous mass, the lumen of the vessels, although greatly diminished, is present, but the muscular coat is destroyed by the neoplastic formation. The basilar artery shows a nodular thickening on one side, and the existence of an organized thrombosis, which partially fills the lumen of the vessel.

CASE 10. *Example of a very early fatal case of basic syphilitic meningitis.* Acute secondary syphilitic meningitis (*Meningite *syphilitique secondaire aigue*). *Presse Medicale*, October 19, 1907, p. 681. Abstract in the *Review of Neurology and Psychiatry*.

A male, aged 18, was admitted to hospital with all the symptoms of acute meningitis. The case at first appeared to be one of tuberculous meningitis. Examination, however, revealed a hard chancre on the penis, but no other signs of syphilis were present. Lumbar puncture showed almost pure lymphocytosis. Four days later the roseola appeared. The diagnosis of syphilitic meningitis was confirmed by examination of the patient's wife, who, in addition to the scar of a vulvar chancre, presented enlarged occipital glands, mucous tubercles in the mouth, and an intense roseola. Under the influence of injections of biniodide of mercury, rapid recovery took place. The chronology of the disease was as follows: chancre middle of June; headache, July 15; meningeal symptoms, August 5; roseola, August 12; recovery from meningitis, August 17. As on previous occasions (vide *Revue de Neurologie*, September 1907, p. 718), examination of the cerebro-spinal fluid for the *Spirochaete pallida* proved negative. The pathogeny of the meningeal affection in the secondary period of syphilis can be explained by the fact that the syphilitic virus has a predilection for the ectoderm, from which both the skin and the nervous system are derived. The meningeal irritations may be regarded as a true syphilide which is often latent, but it may manifest itself apart from lymphocytosis by more or less numerous and acute symptoms.

Case 11. R. H., aged 29, stableman, contracted syphilis July 1897, secondary symptoms well marked; treated regularly for several months at Guy's Hospital, left off the medicine thinking he was well; fresh throat trouble commenced in January 1898, and in February he suffered with severe headache, slight irregular pyrexia, very slow pulse, marked tenderness over the frontal region; he had no squint or vomiting; basic meningitis was diagnosed and he was treated for some months with mercury and iodide. In August 1898, he complained of numbness of the left hand and arm, and a few days afterwards almost suddenly fell down in a fit, but did not lose consciousness completely; was very dazed. He was brought to Charing Cross Hospital with left hemiplegia and dysarthria. He was treated with mercurial inunction and iodide; later he complained of stiffness of the neck and back, became dull and confused, but no obtrusive mental symptoms occurred. He complained of tenderness on pressure in all the limbs, and stiffness, and had to receive morphia injections to relieve the pain; the diagnosis of cerebro-spinal meningitis with endarteritis and softening of the motor region of the right hemisphere was made. The disease began no doubt with a basic meningitis. He was treated with mercurial inunction, and was discharged greatly relieved, and with no acute signs of disease.

Meningitis of the Convexity

One of the characteristics of syphilitic brain disease is that while the disease is advancing in one part, it may be receding or diminishing in another; the case of gumma of the falx cerebri with pachymeningitis illustrated by Plate IV is a case in point; for here we find a large gumma starting in the dura mater surrounded by an extensive pachymeningitis, but a careful examination of the vessels about the base of the brain showed that these had been involved prior to the meningitis of the convexity, for they exhibited a very old and advanced sclerosing fibrosis. Moreover, the majority of cases which have been fatal, and upon which I have had the opportunity of making autopsies, showed that the base was almost invariably affected as well as the convexity, and an arteritis was nearly always found associated with it. Still, cases have been recorded, and I have seen a few clinically, in which the symptoms alone denoted the isolated affection of the convexity.

There are two forms of meningitis: (*a*) circumscribed, (*b*) diffuse. The process may start in the bone or in the meninges and spread thence to the brain, causing a meningo-encephalitis. I have met with several cases and these have sometimes followed a blow on the head which has set up an inflammation either in the bone or in the dura mater at a definite spot, just as a blow on the shin may cause a periosteal node in a person the subject of syphilis (vide Case 12, p. 82). Besides the symptoms of headache already described under basic meningitis, there is a definite severe headache localised to some particular part of the cranium, a tenderness on pressure or percussion over the spot and possibly a difference in the percussion note. The general symptoms of tumour or of meningitis may be present ; if there is a definite tumour formation, sooner or later it will cause increased intracranial pressure, and the general symptoms of tumour will supervene—namely, vomiting, bilateral optic neuritis (choked disk), slow pulse, vertigo, and stupor. In addition there may be symptoms pointing to the local situation of the tumour, according to the region of the cortex in which it is situated. If situated in the motor area, it will give rise to epileptiform convulsions (Jacksonian epilepsy) and monoplegias or a hemiplegia. Now, it has been asserted that when Jacksonian epilepsy occurs, we have a certain indication of the seat of the tumour, and it is important to discuss this question, for experience has shown that a gummatous tumour, which has grown into the substance of the brain, cannot be resolved by anti-syphilitic remedies in the same way as if it were limited to the meninges. I have seen quite a number of cases of this sort associated with epilepsy, or migrainous attacks, some of which have been treated for a long time with anti-syphilitic remedies without relief, and which on post-mortem examination showed a cortical gummatous tumour or tumours. It is probable that absorption of the necrobiotic material in the brain cannot be accomplished in the same way as occurs in a superficial gumma of the bone or skin.

The following cases illustrate some of these points :—

Case 12. J. J., aged 39 years, clerk, came to Charing Cross Hospital suffering with severe pain in the head after a blow ; no relief was obtained by the ordinary remedies. There was a tender area—the size of half a crown—over the upper half of the left occipito-parietal junction. Patient complained of migrainous attacks accompanied by curious visual sensations like a bright light on the left side ; hearing was perfect ; optic disks normal on both sides ; no sickness. With anti-syphilitic remedies he was completely cured.

Cases 13. M. G., aged 31, drayman, formerly a soldier.

Admitted into Charing Cross Hospital with pains in the head. Two years ago attended Ophthalmic Hospital for 'blight in the eye'.

Condition. Ptosis of left eyelid, optic neuritis, vomiting, severe headache, especially on the left side. Said to have had an injury where the pain is most intense. He lies in almost a semi-comatose condition, from which he is roused with difficulty to answer questions, which he does in a rambling, unintelligent manner. Breath very foetid. Face flushed. Pupils dilated and unequal, the right being the larger. Voluntary movement and respiration seem unimpaired. Passes motions and water in the bed. Temperature generally subnormal. Extremities cold. Knee-jerks present. Pulse 64, regular. Came under my care when his brother was admitted into the hospital, and he was immediately put upon large doses of iodide and mercurial inunction. Discharged well enough to resume work at the end of two months, but died six months later of pneumonia. The brother, G. G., aged 32, carman, was admitted into Charing Cross Hospital for pains in the head and vomiting. Syphilis fifteen years ago at the age of 17, for which he was inadequately treated. Contracted it while in the army. He only admitted venereal infection after I had pointed out the serious results of not speaking the truth.

Condition on admission. Severe headache over the right temporal region and forehead, awakening him periodically about four o'clock in the morning. Three days previous to admission he was seized with a fit, followed by weakness of the left arm and left leg. Vomiting without relation to food. Pupils: right somewhat larger than left, and does not react to light. Optic neuritis on the right side. Tenderness on percussion over the right fronto-temporal region. He made a rapid recovery under treatment. The patient remained well for two years, but neglected my advice to attend regularly the out-patient department. His wife came and said that he was again affected; he was admitted to the hospital with left hemiplegia and some thickness of speech. Upon anti-syphilitic treatment he improved somewhat, and was sent to the convalescent home; but I am afraid he will be permanently incapacitated.

The interest in these cases lies in the fact that two brothers who had syphilis developed almost identical symptoms at almost the same age. It is presumed, although the notes do not state it, that M. G. suffered from syphilis, by the symptoms and from the fact that he recovered so rapidly under the anti-syphilitic treatment.

The three previously described cases illustrate the fact that signs and symptoms of intracranial tumour may disappear under the influence of anti-syphilitic treatment. The following case was treated for some time without any benefit:—

Case 14. M. A. R., married woman, aged 29, was admitted to Claybury Asylum, January 1896. She was in a state of acute mania. She had a syphilitic eruption on the limbs and body; there was a history that she had been forgetful for months and had a great number of epileptic fits, and there was a marked history of heavy drinking. It is probable that there was an associated alcoholic polyneuritic psychosis, for her mental symptoms resembled those of Korsakow's disease. There was much mental confusion, confabulation, absent knee-jerks, tenderness of the calves, delusions and hallucinations concerning babies being in the bed with her. The pupils were equal and reacted to light and accommodation, and on admission there was no optic neuritis or vomiting. No oculo-motor paralysis or paresis. Later, however, a fit was observed (of a definite Jacksonian type) which commenced with a twitching of the angle of the mouth on the right side, and spread up the motor area, giving rise to a functional discharge of the cortical centres in definite sequence; and later, a slight facio-lingual paresis on the right side was noticed with considerable hebetude and motor aphasia. Subsequently vomiting and optic neuritis occurred. As no benefit resulted from anti-syphilitic treatment the skull was trephined over the lower end of the ascending frontal, inferior frontal, and ascending parietal convolutions, but no tumour was discovered. She survived the operation four months and for a time seemed to improve. At the autopsy a large caseous tumour was found in the left occipital lobe, another in the left lateral cerebellar lobe, and another involved the inferior frontal convolution. The full notes of this case are given in Vol. I, *Archives of Neurology. Brain Syphilis in Hospital and Asylum Practice.*

Operative measures may then have to be resorted to in order to relieve the general symptoms of intracranial pressure, to save the sight and to abolish the fits. Now if there be a monoplegia in association with the epileptiform convulsions or epilepsy, clearly the tumour extends into the motor area; but if there be no hemiplegia, the fits severe and of *long standing, and signs of intracranial pressure present*, the tumour will probably be situated in the adjacent pre-central or post-central regions—that is to say, in front or behind the ascending frontal convolution. The safest localisation in such case would be a point in front of or behind the region of the ascending frontal convolution which corresponded to the representation of the particular muscular groups in which the fit starts. But to decide whether it is in front or behind we should have to consider: (1) Was the fit preceded by numbness or tingling? (2) Is there any loss of muscular sense? (3) Is there any tactile motor defect appreciable by the individual in performing any acquired expert technical work? (4) Is there loss or diminution of the stereognostic sense? Any or all of these sensory disturbances point to the tumour being situated behind the fissure of Rolando in the ascending parietal or the marginal convolution. The irritation of the tumour in such a case spreads forward to the ascending frontal convolution (the region of the psycho-motor cells) and produces the epileptiform convulsions. If on percussion the tenderness indicated the seat of the tumour as being situated behind the fissure of Rolando, there would be no doubt as to its situation; if, however, there were none of these sensory troubles, but a tremor in the hand of the same side, associated with absence of the abdominal reflex on the other, together with tenderness on percussion in front of the ascending frontal, then the tumour would be localised in the frontal lobe. Certain other signs of tumour in the frontal lobe should be remembered. If it is on the left side, it may give rise to speech defects and epileptiform convulsions, and I have known such a case wrongly diagnosed as general paralysis by experienced authorities; it might be said that an examination with the ophthalmoscope would reveal optic neuritis, and this would point to the existence of a tumour, but it must be remembered that optic neuritis may be late in its manifestation or even absent in some tumours of the frontal lobe (vide Plate IX). A syphilitic tumour affecting the orbital surface of the frontal lobe may press upon the olfactory nerves and give rise to irritation phenomena with a sensory smell aura, or to unilateral anosmia. Epileptiform convulsions may present every gradation or transition, from a local convulsive spasm to general epilepsy. It must not be supposed, however, that every case of epileptiform convulsion or epilepsy in a person with well-marked signs of syphilis is of necessity due to a gummatous syphilitic meningitis or a gummatous tumour of the convexity, as it may be the result of softening from arteritis or it may be an epilepsy arising in a person with an inborn tendency to fits which the syphilitic poison has developed; or it may be the epileptiform convulsion of a general paralytic. In fact there is great difficulty in deciding sometimes between syphilitic brain disease with epileptiform convulsions and true general paresis by the character of the fits only. This, however, will be discussed more fully in the diagnosis.

Cases of cortical epilepsy of syphilitic origin may begin, as I have often seen, with a history of localised Jacksonian epilepsy (vide Case 15, p. 87), but in time the fits spread so as to involve more and more of the motor area of the same side, and they then pass over to the opposite side; and with this extension of the spread there is an increase of the rapidity of onset; so that eventually it becomes very difficult to distinguish these cases which have started primarily from organic disease from true symptomatic epilepsy. A difference in the size of the pupil or in the reflexes on the two sides, with a hemi-paresis or hemiplegia, would certainly indicate the organic origin of the epilepsy. Such cases are not very uncommon in the asylums.

Now the gummatous tumour or syphilitic pachymeningitis may be situated in other regions of the brain and give definite localising symptoms. Thus homonymous hemianopsy, partial or complete, may arise from a gumma in the occipital lobe involving the optic radiations or calcarine regions. A gummatous tumour in the left hemisphere, if deeply seated, may cause a motor aphasia ; word-blindness when situated in the angular region, or word-deafness if situated in the posterior third of the first temporal and the adjacent gyri of Heschl; when Broca's convolution is involved there is motor aphasia or dysarthria (difficulty of articulation) usually accompanied by facio-lingual palsy. In a case of Wernicke's a bilateral gummatous lesion produced deafness. Gummatous tumours anywhere in the speech zone may, by involving the 'association fibres' of the various speech centres, produce paraphasic and amnesic conditions. Likewise lesions of the parietal lobe have caused apraxia and parapraxia.

The following case is of unusual interest as regards localisation :—

Case 15. A. G., aged 44 years. Admitted to Hanwell, March 13, 1908, for epilepsy, loss of memory, and aphasia from which she for a time improved. The history obtained showed that her husband had had syphilis eight years ago. She had been married over six years to him. She was his second wife and had had no children or miscarriages by him. There were several papery scars on the body and there was some slight glandular enlargement, but the signs of syphilis were not definitely distinctive. Still the symptoms pointed strongly to syphilis, and in my judgement it was desirable at once to push anti-syphilitic treatment with mercurial inunction after attending to a bad condition of pyorrhoea alveolaris and stomatitis. I saw this patient on May 17, 1908, my attention being called to the case by Dr. Daniel under whose care she was. I found some paresis of the right lower half of the face with marked deviation of the tongue to the right. She was unable to close the right eye independently of the left, although she could wink and close the left eye independently perfectly well when asked to do so. There was some weakness of the right hand as compared with the left and the deep reflexes were increased. She tried to talk but her speech was hardly intelligible, although she understood all that was said to her, as was shown by her obedience to all commands and the endeavours she made to reply to questions ; it appeared that her condition of speech defect was more that of dysarthria than motor aphasia; for the words she uttered were all intended to represent correctly her silent thoughts. She is unable to read or write, and therefore, could not be tested in this respect. I saw her in several fits. They come on quite suddenly; when asked whether she knows when a fit is coming on, she points to her tongue and lower half of right face. I asked her if she felt a numbness there, she responded in the affirmative. She does not lose consciousness, as she will obey commands while the fit is proceeding. The fit starts in a spasm of the muscles of the lower part of the right side of the face and jaw, this spreads up and down to the right orbicularis palpebrarum and corrugator supercilii, which are thrown into spasm, also the platysma of the neck. I thought there was some deviation of the eyes to the right on one occasion, but she was able to look to the left when told to do so while the fit was proceeding. The spasm of the orbicularis palpebrarum spread to the opposite left eye and the eyeballs rolled upwards; it did not spread to the opposite lower face, nor did it spread to the arm. She has never complained of headache, but there was a tender spot on pressure just above the attachment of the left ear to the skull. There was no optic neuritis and no vomiting. The diagnosis I made was gummatous pachymeningitis over the region of the left ascending frontal, and parietal convolutions at their lower extremity, involving especially the tongue area, also probably the *pars basilaris* of the third frontal.

Subsequent notes by Dr. Daniel.

May 17, 1908. The notes state that the fits continue on an average about fifty a day. One fit lasted about thirty minutes (probably it was a series fused together) but it is interesting to observe *that she remained for one and a half hours unable to speak at all.*

May 20, 1908. She has had fifty fits in the night and they are occurring every few minutes in the morning. Yesterday she complained of numbness and pains down the right arm. To-day *there is distinct deviation of the eyes to the right during the tonic stage of the convulsion*, and the fits are occasionally attended by loss of consciousness. She is now being treated by mercurial inunction twice a day.

May 26. The notes state that the fits now extend to the right arm and various sedatives were given, including Hyoscine $\frac{1}{50}$ grain, which it is stated has had a marked effect, she has had fewer fits and is markedly drowsy this morning, the pulse is feeble and rapid.

May 30. A difficulty in swallowing has been observed and there seems to be an actual paresis. Fits continue practically uncontrollable.

June 1. The fits ceased, but patient died June 2, at 4.35 p.m.

On June 3 I made the post-mortem examination.

On removal of the calvaria a pachymeningitis about the size of a florin was observed in the region of the tender spot noticed during life just $\frac{3}{4}$ inch above the attachment of the left ear. On opening the dura mater the thickening was very definite. It was about five times as thick as the normal dura mater. This thickening was uniform except at the circumference where it gradually sloped off. It was red and inflamed, both externally in contact with the bone, and internally in contact with the pia arachnoid. The bone in contact with the inflamed dura was roughened and there was a slight degree of osteitis; the middle meningeal artery markedly thickened, passed through the middle of the patch. Internally the pia arachnoid was red and inflamed, but there was no adhesion to the *dura mater* in this situation. One inch and a quarter further back the *dura mater* was a little thickened (twice the normal) and adherent to the pia arachnoid, so that on stripping it off, erosion of the surface of the brain occurred over an area about the size of a florin at the end of the fissure of Sylvius, involving the posterior end of the first temporal, the adjacent marginal, and to a very slight extent the angular gyrus.

Upon close examination the anterior patch of pachymeningitis showed several small caseous nodules about the size of a hemp seed; it was found to be situated exactly over the lower end of the ascending frontal and the adjacent inferior frontal and ascending parietal convolutions. There can be no doubt that this gummatous pachymeningitis was the cause of the Jacksonian epilepsy; and it could have been removed by operation with the greatest of ease. At the autopsy no organic disease of other organs, nor of the brain itself, was found and it was a great pity that the patient was not sent to a hospital as I recommended, for in my judgement it was a most suitable case for surgical treatment. Notes on the microscopic examination of these tissues are given in explanation of Plate VIII.

She would have been transferred at once had there not been legal difficulties and formalities to overcome.

Such speech defects may arise much more frequently from softening caused by blocking of arteries supplying these areas, or by destroying or damaging the fibre systems which associate the several centres of the speech zone.

It is necessary to mention that cases occur in asylums where auditory and visual hallucinations have been prominent symptoms and, occasionally, in these cases a gummatous tumour has been found (as I have seen) involving the visual or auditory area of the cortex; and it has been inferred that the irritation of these primary centres has been the cause of the hallucinations. But seeing that tumours situated in any part of the cortex of a person who is potentially insane, or with an inborn mental instability, may develop hallucinations of hearing and vision,—indeed, hallucinations of hearing is one of the most common symptoms met with in insanity,—it would be obviously illogical to assert that the tumour was necessarily the cause of the hallucinations when it was situated in this particular region.

When the gummatous tumour or meningitis is situated in those portions of the brain which Flechsig terms association centres, it would be difficult to localise the situation by the symptoms, except by the local tenderness on percussion. The nearer the tumour is to the primary fissures of Sylvius, Rolando, or the Calcarine, the more likely are definite localising symptoms to occur. The accompanying figure indicates the chief features relating to cerebral localisation, and will enable the reader to understand the effects a tumour might produce when situated in the cortex of the left hemisphere of a right-handed person.

Plate VIII.

Section from a case of syphilitic pachymeningitis. A large branch of the middle meningeal artery seen in transverse section. Magnification 40 diameters. The endarterium has shrunk away from the inside of the vessel, but the proliferative hyperplasia has been so great as to practically obliterate the lumen. The fibrous tissue around is infiltrated with lymphocytes and plasma cells, as shown in the accompanying figure of a small portion under a magnification of 500 diameters.

To face p. 90.]

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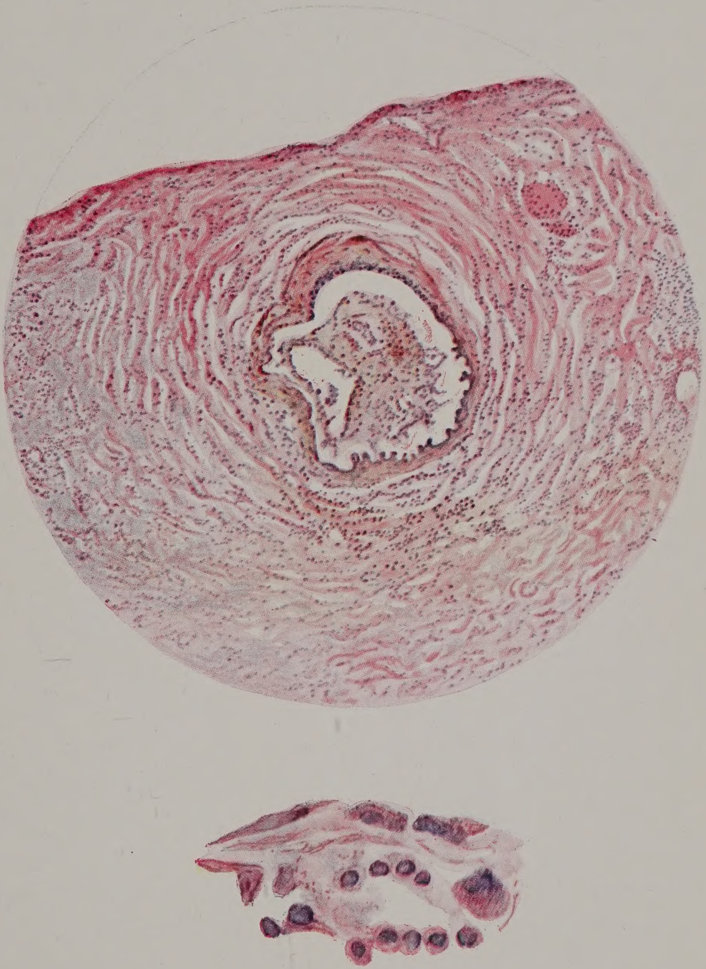
PLATE VIII.



Charcot considered cortical epilepsy to be one of the commonest results of brain syphilis, but Naunyn found only 3 per cent. in over three hundred collected cases. Without a post-mortem examination statistics are not very reliable, and should the autopsy be made some long time after the onset of the disease, regressive changes may have occurred to such an extent (especially if iodide has been given), that, although the fits at first localised have been followed by general convulsions indistinguishable from epilepsy, little is left behind to show the original meningitis which gave rise to the initial symptoms. I am convinced that I have seen several of these cases. Some of the cases of diffuse meningitis and meningo-encephalitis reported were probably cases of general paralysis; for the authorities who have described this condition have sought to differentiate them from general paralysis by the absence of grandiose delusions, but it must be remembered that a large number of cases of general paralysis do not show this symptom, and there are many atypical forms of the disease in which forced movements, clonic spasms, epileptiform convulsions of a Jacksonian type, active contracture, and stiffness of the neck with retraction occur. I have seen such cases in which at autopsy nothing else was found except the ordinary naked-eye changes of general paralysis. Any one who had not seen a great number of cases might easily think they had to do with a diffuse meningo-encephalitis, especially if there were signs of syphilis on the body. I have, however, recorded two cases, and seen several others, which neither by macroscopic nor microscopic examination of the nervous system could be looked upon as examples of general paralysis, although there was marked atrophy of the brain and spinal cord, with patchy thickening of the membranes. I consider these to be true primary meningo-encephalitis of a nature somewhat similar to the meningo-encephalitis of lead poisoning from which they are often difficult to diagnose, especially when plumbism and syphilis are combined in the same individual.

Syphilitic Arteritis

Meningitis, whether in the diffuse form or in the form of a localised gummatous tumour, is always associated with some degree of endarteritis. The symptoms of meningitis usually precede those of arteritis, but they may be simultaneous or even successive. In the cases occurring within the first two years after infection the morbid process is more extensive and widespread than the symptoms indicate. But cases do occur in which the symptoms of arteritis precede any symptoms of meningitis, and in fact are independent of any signs of meningitis at the time or subsequently. Symptoms of arteritis may occur almost at any time after infection. The earliest case I have myself seen independent of any signs of meningitis was the following :—

Case 16. A commercial traveller, aged 38, who six months after infection, while seated at the piano singing a comic song to his own accompaniment, suddenly became faint and speechless. His friends were at first amused, and did not realize that it was not a part of the entertainment. They then came to his help and gave him a glass of water which he was unable to swallow, the fluid regurgitating through the nose. This was followed the next day by paralysis of the left leg, left arm, and left side of the face, including the upper part, and for a month he had to be fed with a tube. This happened in Japan; the doctor treated him by inunction, and after a month he was able to swallow and speak. He was sent to me on his return from Japan suffering with the remains of a left-sided paralysis, including the upper facial muscles, and there was also paresis of the left vocal cord and soft palate. He attended my practice for some years without further symptoms and gradually improved.

Thus we see by this case that an attack caused by occlusion of a vessel may occur independently of any previous meningitic symptoms, or, as far as we know, for at least three years after without any signs of meningitis.

About one-fourth of the cases (according to Gowers) of arteritis with clinical symptoms occur within the first two years. It is right to mention *clinical symptoms* because a number of cases doubtless occur in which there may be some slight and overlooked meningitis or arteritis, but not sufficiently extensive or intense as to give rise to symptoms which will bring the patient under observation. The symptoms of arteritis may be due to general thickening of the intima, causing occlusion or partial occlusion of the vessels and interfering with their contraction and dilatation, both by the change in the muscular coat as well as by the effect of the disease on the vasomotor nerves ; but, as a rule, the obtrusive signs which terminate in actual localised loss of function, are more often due to thrombosis of a diseased vessel. There is no time limit to the possibility of symptoms arising from endarteritis, the result of syphilitic infection ; still, as a rule, according to my experience, it is in young male adults within the first few years after infection that it occurs, and more often associated with signs of meningitis than not. A typical case is given on p. 80. Arteritis is unusual as a result of hereditary syphilis, but all the arteries of the circle of Willis were affected in Case 56, p. 438, and Siemerling relates a case which occurred in a boy 14 years of age; also Barlow and Bury have recorded cases. Arteritis may first manifest itself by an apoplectic attack, and preceding this, various prodromal symptoms often occur, namely, headache, giddiness, sleeplessness, and various psychical changes in the form of irritability of temper, incapacity for mental work, lack of decision of character, weakness of memory, especially for recent events, slowness of thought and weakness of ideation. These symptoms, however, are not characteristic, and may occur in other conditions of cerebral anaemia or in psychasthenia.

SYMPTOMATOLOGY

Headache.—The headache is not so severe as in meningitis, it may exist for months or years before other symptoms arise. It may be severe and usually is worse at night. It is rarely localised, and is difficult to differentiate from arterio-sclerosis in later periods of life. It may be intermittent and then it is usually more severe while it lasts, which may be weeks or months ; it may then disappear for a time, again to reappear ; it is usually increased by mental activity and sometimes even by bodily effort.

Giddiness.—The patient may be subject to short attacks of giddiness, but they may last weeks or months and be the sole obtrusive symptom of which the patient complains. They are relieved by rest, and the patient tends instinctively to lie on his back, but if he be made suddenly to assume the erect posture a feeling of giddiness and faintness may be experienced owing to the inability of the diseased vessels to readjust the circulation in accordance with the necessity of altered gravitation caused by the sudden change of position.

Sleeplessness.—This may be transitory or chronic or the sleep may be restless, the patient waking in the morning unrefreshed.

Psychical symptoms may be manifested by mental fatigue and incapacity for work associated with abnormal excitability; sometimes there is an incapacity of power of thinking and an enfeeblement of intelligence or a general obtuseness, associated with an emotionality and tendency to cry. The patient often exhibits a *semi-somnolent,* half-intoxicated condition with a lack of power of recalling afterwards what has happened. Periods of excitement may alternate with conditions of apathy, and longer or shorter periods of somnolence may occur in which the patient performs actions in a semi-automatic somnambulistic manner. As already mentioned in the description of basic meningitis these semi-somnolent, semi-conscious, semi-comatose conditions are especially suggestive of a widespread endarteritis, producing cerebral anaemia; and although regressions, even to the patient recovering consciousness in almost a complete manner, may occur, the fact of the existence of this condition is of evil omen because many such cases soon relapse and terminate fatally. This drowsy sleepy condition is especially noticed by the wife or friends of the patient, as Case 5, p. 52, shows. We shall see that this accords with other symptoms which are at first transitory but eventually become permanent. The transitory character of the earlier phenomena before the occurrence of thrombosis is a very important feature of the disease. It can be easily understood that if one or more of the large arteries be partially occluded, considerable variations of the blood-supply and blood-pressure in the hemispheres may result, and this accounts for fainting fits and loss of consciousness, mistakable for a true apoplectic seizure of general paralysis. The onset of symptoms may be quite sudden and without any of the prodromal symptoms previously mentioned, as we have seen in the case related above; moreover, there is not necessarily a loss of consciousness, especially when the hemiplegia comes on gradually. There is no loss of consciousness when the clotting in the vessel is gradual, or when the blocking of the vessel does not seriously interfere with the cortical functions. But various conditions of apoplectic seizure may occur, varying from slight disturbances of consciousness, giddiness, nausea, and stupefaction to complete loss of consciousness; in some cases associated with convulsions. Apoplectic seizures may occur during sleep; they may follow excesses in *baccho et venere* or physical or bodily strain. These seizures present no essential difference from the apoplectic seizures met with in other diseases, except that they usually occur in young male adults between 20 and 35, an age in which haemorrhage or thrombosis of the vessels from other causes is rare. Of course, exception should be made to valvular disease of the heart and subsequent embolism. A characteristic of the seizure is that, if a slight one, the defect is of a transitory character. One of the earliest symptoms, as Charcot pointed out, is a transitory aphasia; sometimes it is loss of memory of words, but there may be any form of speech defect. This transitory trouble of speech may occur several times in the day; there may be in others, astereognosis, asymboly, apraxia,[*] temporary word-blindness, word-deafness, or other forms of disordered vision or hearing. A paraphasia is perhaps the most frequent of the speech troubles met with. Again, one of the first symptoms may be a transitory monoplegia, hemiplegia, or hemiparesis, ushered in by numbness or tingling of the part. The paresis or paralysis may last a few minutes, a few hours, or a few days, and then may disappear again to return and eventually end in a permanent loss of function and contracture. In some cases there is a hemiplegia *gradatim*, that is to say, the paralysis gradually spreads over one side of the body. A monoplegia or this gradual mode of onset of hemiplegia indicates a cortical lesion. The patient can sometimes describe exactly the onset of the paralysis or aphasia, but usually at the time that it occurred there was giddiness, dullness of perception or somnolence, and these symptoms persist sometimes after the paralysis has passed off. It is much more common to find loss of motor power than loss of sensibility, but various sensory phenomena may occur, such as pain, numbness, and tingling in the limbs, hemianaesthesia, and hemianopsy. A reference to Plates IX and X will help the reader to understand the varied symptoms which may arise from occlusion of arteries supplying different regions of the brain, how collateral circulation of cortical vessels can be established. That hemiplegia should be so frequent a result is due to the fact that the middle cerebral artery and its branches to the basal ganglia and internal capsule, especially the latter, are frequently and intensely affected by the endarteritic process. I have seen a syphilitic case in which the large arteries at the base were only slightly affected by an endarteritis, but all the small arteries that enter the basal ganglia and internal capsule and supply the white matter of the centrum ovale were more or less completely occluded (vide Plate XI). There was a history in the case of a right hemiplegia when the patient was 31 years of age, at 37 he was admitted to an asylum, and on account of the convulsive seizures and dementia and speech defects it was diagnosed as general paralysis. No naked-eye signs or microscopic evidence of general paralysis were found post mortem, but multiple softenings in the basal ganglia and centrum ovale, and old atrophic sclerosis of the left internal capsule and lenticular nucleus which accounted for the speech defect observed during life.

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[*] These terms are used to imply the following conditions:—

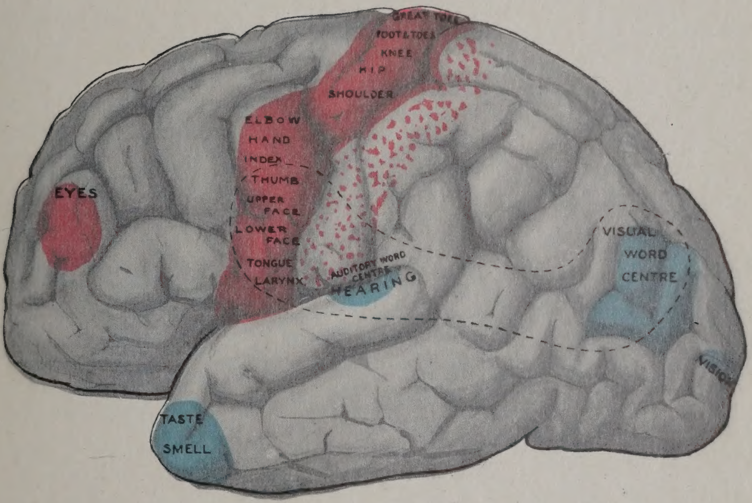
Astereognosis (α priv.; στερεός, solid; γιγνώσκω, to know).—Loss of the faculty of recognizing solid bodies having three dimensions.

Asymboly (α priv.; συμβολή, convention, symbol). Disorder or loss affecting especially gestures and conventional signs, e. g. inability to make the sign of the cross, to play an instrument, to recognize the value of coins.

Apraxia (α priv.; πράττειν, to act). Disturbance of acts usually performed by one side of the body; these acts are maladroit whether they be spontaneous, imitated, or the result of a command.

Homonymous hemianopsy may arise from occlusion of a posterior cerebral artery causing softening of the optic radiations and calcarine region of the occipital lobe (vide Plate XII).

PLATE IX.


GREAT TOES
FOOT & TOES
KNEE
HIP
SHOULDER
ELBOW
HAND
INDEX
THUMB
UPPER FACE
EYES
LOWER FACE
TONGUE
LARYNX
AUDITORY WORD CENTRE
HEARING
VISUAL WORD CENTRE
VISION
TASTE
SMELL

Photograph of the left hemisphere, showing various localised cortical areas, the transparency illustrating the various regions. The motor regions are red; the dotted region indicates the kinæsthetic area. The sensory regions are blue; the small blue area at the end of the first temporal convolution is only a very small portion of the primary auditory region, the greater part lying within the Sylvian fissure forming the gyri-transversales. The primary visual area (half vision centre) is almost entirely situated in the Calcarine region of the mesial surface of the occipital lobe.

PLATE IX.

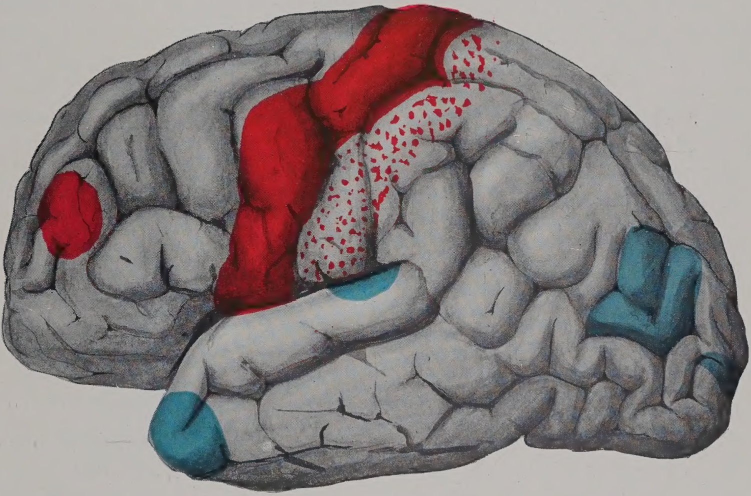


PLATE X.

Arterial supply of the brain after Cunningham. It will be observed in Figure A—the external surface of the left hemisphere—that the middle cerebral supplies the greater part of the external surface. Thus, by reference to Plate IX, it will be seen that the speech zone, the greater part of the motor area, the left cortical auditory centre and word centre, and a part of the visual word centre, are supplied by the middle cerebral (blue). The middle cerebral also gives off branches to the anterior perforated spot to supply the capsule and basal ganglia. Consequently occlusion of this artery would give rise to serious speech defects and hemiplegia.

In B the distribution of the anterior and posterior cerebral is seen. The anterior cerebral supplies the mesial surface and the upper end of the motor region which represents the leg. Consequently its occlusion would give rise to paralysis of the right leg especially. The posterior cerebral supplies the occipital and temporal lobes. Its occlusion would cause destruction of the half vision centre and hemianopia.

C shows the base of the brain with the circle of Willis, formed by the basilar giving off the two posterior cerebral arteries, which are connected with the middle cerebral by the posterior communicating; the middle cerebral being connected with the anterior cerebral by the anterior communicating. It will be observed that more than two-thirds of the hemisphere is supplied by the internal carotid; the basilar, formed by the junction of the two vertebral arteries supplying the remainder, the pons, medulla, and cerebellum.

PLATE XI

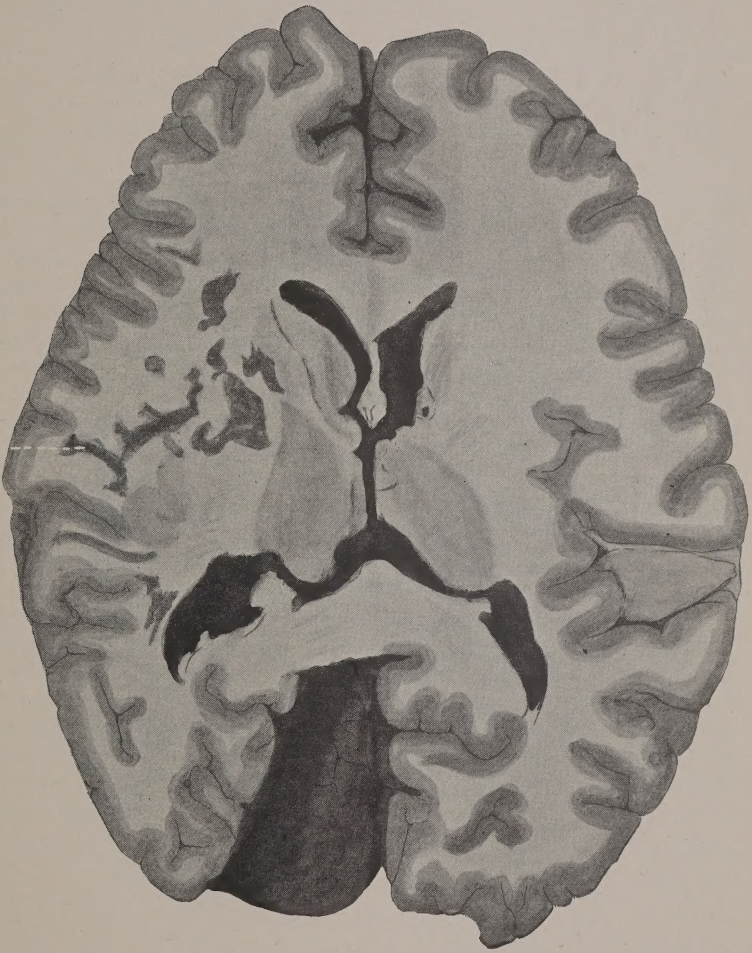
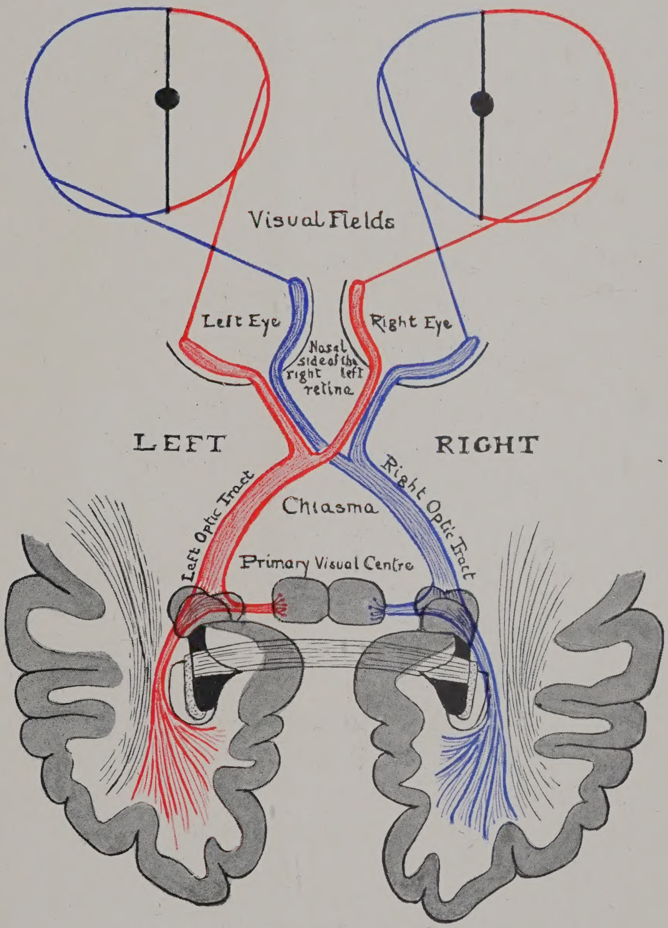


PLATE XII.

Schematic diagram to illustrate the optic tracts after Knoblauch. It will be observed that the visual fields are represented by two figures, divided into two unequal portions; these two figures severally correspond to the perimeter fields for each eye. The black point represents the fixation point. In binocular vision the right half of the field of vision falls upon the nasal half of the retina of the right eye and the temporal half of the retina of the left eye (red); the converse is true for the left half of the field of vision (blue). A lesion of the optic nerve will produce blindness of one eye. A lesion of the optic tract will cause loss of the opposite half of the field of vision, homonymous hemianopsy. So also will a large lesion of the occipital lobe sufficient to destroy the optic radiations and the striate calcarine area where these radiations end. The calcarine cortex represents the perceptive centre for the nasal half of the retina of the eye of the opposite side and the temporal half of the retina of the eye of the same side. If the lesion involves the optic tract then the fibres which enter into the light reflex will be damaged, and a beam of light focussed by a lens on the nasal side of the opposite retina will not cause a pupillary contraction. In this way sometimes a lesion causing homonymous hemianopsy can be located to the optic tract. A glance at the diagram shows that if the hemianopsy is due to a lesion involving the optic radiations in the occipital lobe, the light reflex arc will be intact, and therefore a beam of light thrown on the nasal half of the retina of the opposite eye or the temporal of the eye of the same side will cause contraction. The absence of the light reflex under these conditions is termed Wernicke's pupil phenomenon.

To face p. 96.]

PLATE XII.


Visual Fields
Left Eye
Right Eye
Nasal side of the right left retina
LEFT
RIGHT
Left Optic Tract
Right Optic Tract
Chiasma
Primary Visual Centre

Syphilitic endarteritis of the lenticulo-striate arteries may cause patches of softening of variable size in the basal ganglia (corpus striatum and optic thalamus) and the internal capsule. The most varied symptoms may arise therefrom, in the form of hemiplegia, triplegia, hemiplegia of one side with hemiparesis of the opposite side. Occasionally, when the damage is in the anterior third of the posterior segment of the internal capsule on both sides, a condition of pseudo-bulbar paralysis occurs. An interesting case of this kind has been described by the late Dr. Beevor.

Case 17. A young man, aged 23 years, the subject of syphilis acquired three years previously. This patient suddenly lost power in the left side of the face, the left arm and leg, without unconsciousness. For two weeks after this attack he was unable to open his mouth and his speech was indistinct, but it recovered almost completely. Four months later he lost power in the arm, leg, and face of the right side, and his speech was again affected. He recovered from this attack, but seven months later he was suddenly paralysed in the face, arm, and leg of the left side. He lost speech completely, and he was unable to swallow or to control his sphincters. This patient presented the clinical features of pseudo-bulbar paralysis. He had lost voluntary power over all the muscles of mastication, deglutition, and phonation, and, besides, all the voluntary movements of respiration were lost as well as closing the eyes, elevation and retraction of the angles of the mouth, opening and closing the mouth. The emotional movements of laughing and crying were preserved, and, as has been observed in other cases, the patient was continually laughing and the reflex (but not voluntary) movements of coughing, sneezing, and yawning were readily obtained. Dr. Beevor considered that in this case the lesions were symmetrical thrombotic occlusions of the branches to the internal capsule of the posterior communicating arteries on both sides due to a specific arteritis.

A case of a somewhat similar nature died in Claybury Asylum, and is briefly described on page 50.

There are no characteristic signs of lesion of the corpus striatum, and it is seldom that in syphilitic disease of the lenticulo-striate arteries a lesion is limited to the basal ganglia; the capsule is nearly always simultaneously involved to some extent. Still, should the following syndrome present itself a thalamic lesion may be expected: (1) a superficial persistent hemianaesthesia of organic character more or less marked for superficial sensibility (touch, pain, temperature), but always very pronounced for deep sensibility; (2) a slight hemiplegia, habitually without contracture and regressive; (3) a slight hemiataxy and astereognosis more or less complete; (4) sharp pains on the affected side, persistent, paroxysmal, often intolerable and not yielding to any analgesic treatment; (5) choreo-athetosal movements in the limbs of the paralysed side. (Roussy.)

The most serious symptoms arise when occlusion of the basilar artery occurs; such a condition is almost invariably fatal. I recently made an autopsy upon an asylum patient, a woman past middle life, who suddenly became unconscious; *Cheyne-Stokes breathing* supervened, and she died two hours after the stroke. I found an endarteritis of the basilar with recent extending thrombotic occlusion. Sometimes a partial obliterative endarteritis may affect this vessel and extend into some of the branches which it sends into the pons. These arteries are terminal and occlusion leads to a patch of softening which may involve important nuclei and conducting tracts. The same applies to the crus cerebri, and a softening, due to syphilitic arteritis there, causes an alternate hemiplegia; thus there would be paralysis of the motor oculi of one side, with paralysis of the face, arm, and leg of the other. If the softening is in the pons or medulla it may involve the nuclei of important cranial nerves, and the symptoms arising from this may be associated with a hemiplegic condition of the limbs of one side, due to involvement of the pyramidal system of the brain before it has decussated, associated with a paralysis of a cranial nerve. An alternate hemiplegia may thus arise, e.g. when the facial nucleus is involved in association with the pyramidal system of the arm or leg of the opposite side before it has decussated.

It might have been thought that this condition would have been found in the following case where the patient had a left peripheral facial paralysis and a right hemiplegia, but the latter preceded the former, and it was shown at the autopsy that a gumma of the facial nerve was the sole cause of the facial paralysis, and a softening in the internal capsule of the left hemisphere was the cause of the right hemiplegia. This case is a good illustration of the polymorphic character of syphilitic brain disease.

Case 18. Male, aged 45 years. Admitted to Long Grove Asylum, October 21, 1907. History from wife :—Married seven years. Two healthy children aged 6 and 5 years respectively. As a naval reserve man, he was sent to South Africa. Two years ago, after his return, she had a child born dead at five months. Probably therefore he contracted syphilis while away. She noticed nothing wrong with him till last April, when he gradually began to lose power in his right arm and leg; at the same time he complained of severe pain at the back of the head. His memory became defective and he rambled in his conversation. A week later his speech became suddenly affected (dysarthria) ; after a few days the speech improved and the headache passed off ; a few weeks later the speech again became bad. About two months after the first onset of symptoms his left leg became partially paralysed ; it improved considerably, but the paralysis of the right arm and leg became stationary. His wife noticed facial paralysis soon after the first attack ; the ectopion was not noticed until admission to the infirmary. Since the attack he has become emotional and easily upset ; he has never suffered from insomnia, and has always taken his food well.

On admission to the asylum syphilitic scars were observed in various places. The notes state that there was hemiparesis of the right side with exaggeration of deep reflexes, peripheral left-sided facial paralysis, marked dysarthria, slight double ptosis, ankle clonus, and Babinski's sign on the right side. He lies in bed in an apathetic, drowsy, lethargic state, taking little notice of his environment, and answers questions although there is marked difficulty of utterance. There is no impairment of immediate perception, and his answers are relevant, but there is much confusion of orientation in time and place. He can do multiplication sums correctly, but takes a long time. His memory for remote events is good, but for recent events is much impaired. There is considerable motor inco-ordination, especially when he attempts refined movements, e. g. writing. He has no hallucinations or delusions. He frequently passes urine and faeces in the bed. His condition became worse and ten days later coma supervened. The temperature rose to 105°, and he died sixteen days after admission.

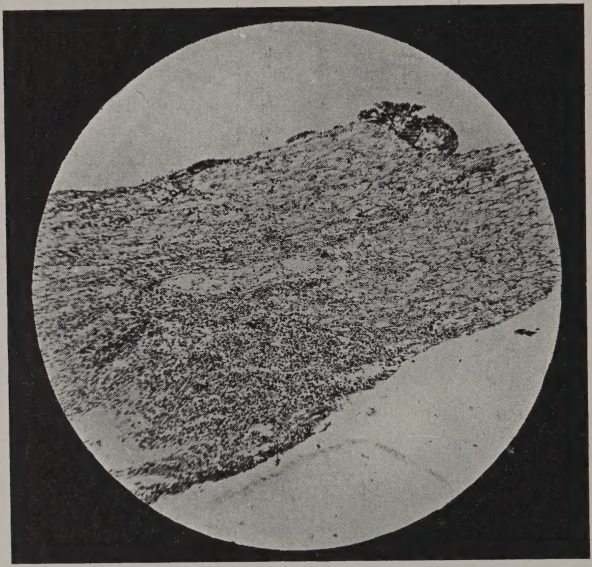


FIG. 7. Photomicrograph of gummatous facial nerve. Magnification 20 diameters.

Post-mortem examination.—There was a widespread generalized endarteritis affecting all the arteries of the circle of Willis and their branches (vide Plates VI and VII, Fig. A). Particularly were the lenticulo-striate arteries affected and the lumina of some of the smaller vessels were almost completely obliterated, thus accounting for small patches of softening found in the basal ganglia of the left hemisphere and in the genu of the internal capsule. There was also a small patch of more recent softening in the thalamus of the right hemisphere, moreover, there was a gummatous swelling in the facial nerve (vide Figs. A and B, Plate XIII), and the adjacent side of the pons showed a small

PLATE XIII.

A section of a gummatous swelling of the facial nerve at its origin, showing a shallow depression on the adjacent side of the pons, producing peripheral facial paralysis. **A.** A caseous mass. **B.** Swollen inflamed nerve.

A. A section of the caseous mass, magnified 600 diameters, showing (*l*) lymphocytes and (*pl.c.*) plasma cells, many of which are undergoing nucleolysis and plasmolysis and caseous degeneration, intermingled with strands of fibrous tissue.

B. A section of the nerve, showing (*pl.c.*) plasma cells and (*ax.*) degenerated axis cylinder processes.

To face p. **100.**]

multiplication sums correctly, but takes a long time. His memory for remote events is good, but for recent events is much impaired. There is considerable motor inco-ordination, especially when he attempts refined movements, e.g. writing. He has no hallucinations or delusions. He frequently passes urine and faeces in the bed. His condition became worse and ten days later coma supervened. The temperature rose to 105°, and he died sixteen days after admission.

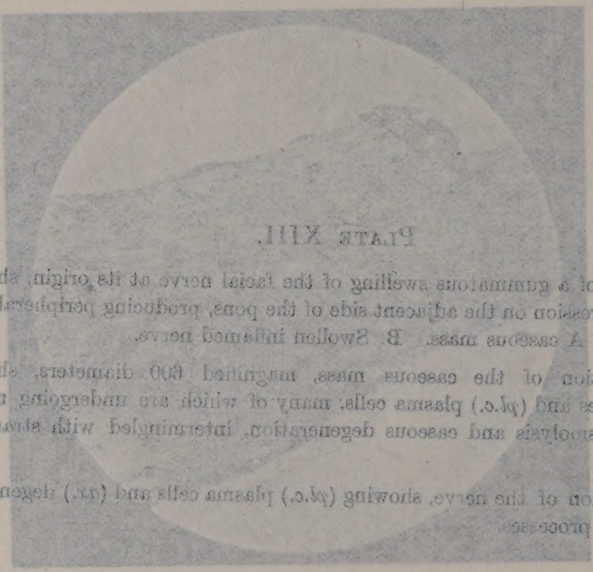


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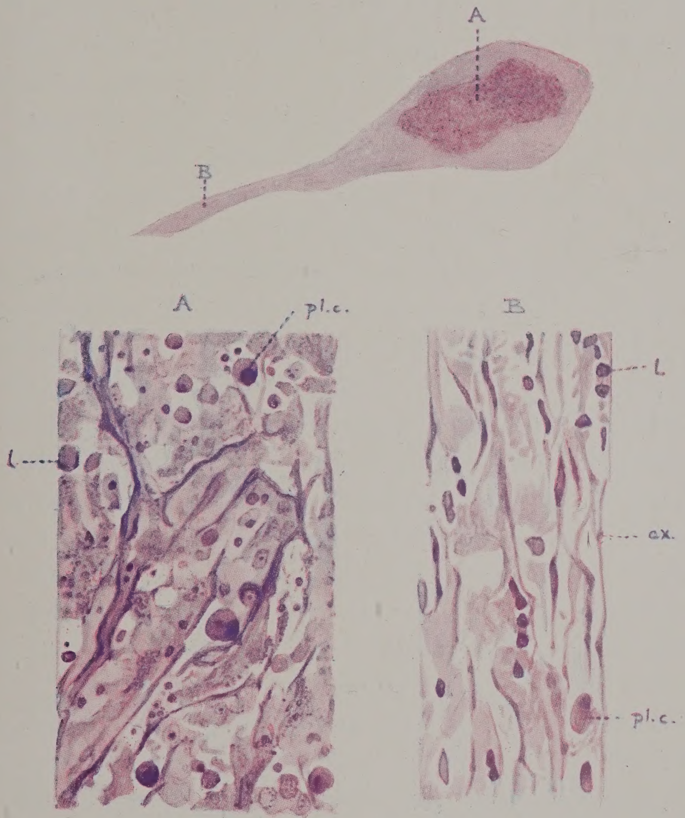
PLATE XIII.


A
B
A
pl.c.
B
l
l
ex.
pl.c.

shallow depression due to softening. There was no naked-eye evidence of meningitis of the base.

No doubt the right hemiplegia, which came on before the facial paralysis, was due to the softening in the left internal capsule, and the peripheral facial paralysis was due to the involvement of the facial nerve and its root of origin by the gummatous process. In bulbar cases dysarthria is associated with difficulty in swallowing and other bulbar symptoms, and when such occurs disease of the basilar or vertebral arteries is indicated. Various difficulties of speech, namely, a curious drawling staccato speech without any distinct paralysis of the muscles of articulation, have been found associated with multiple softenings of the hemispheres of a widespread nature. A peculiarly characteristic feature of the syphilitic arteritis is triplegia. Thus supervening on a hemiplegia may be a monoplegia affecting arm or leg of the opposite side. In the case related above this occurred, but a triplegia may occur also in syphilitic cerebro-spinal meningitis associated with general arteritis. Thus a hemiplegic patient from arteritic softening may become paraplegic from a meningo-myelitis. A number of cases of syphilitic arteritis live a considerable time, partially or totally incapacitated by mental affections associated with paralysis or either conditions separately, although it is rare not to find some degree of both. A number of these cases eventually succumb after having been restored to apparently good health. The following case is of interest as it shows that a syphilitic endarteritis, although seemingly cured, leaving an invalid brain, may again become active and end in the patient dying in an asylum of symptoms not unlike general paralysis.

Case 19. Male, aged 34, a horse-breaker, was admitted to Claybury Asylum, July 3, 1908, died July 17, 1908. I obtained the following history from the wife. They had been married eight years, she had no children and no miscarriages. About eighteen months after marriage he had a fit, fell down unconscious, foamed at the mouth, and passed water; he continued on and off to have fits, sometimes slight, but occasionally severe; after some months he complained of headache; it was worse at night; there was drooping of the left eyelid; then he used to complain of a numbness in his right hand and arm and weakness, which would pass off; his mouth became drawn and his speech thick; he became irritable in temper; his memory failed him; he did foolish things in consequence, he was unable to follow his business, and he was admitted to the London Hospital, November 10th, 1901, under Dr. Henry Head; who has kindly sent me full notes of the case. It appears the man contracted syphilis when he was 24, and according to the father's account he had severe symptoms. The notes taken by Dr. Head himself are as follows: Speech thick, no aphasia, no word-deafness, no headache now, but before admission he had headache in the back of the head, no vomiting, no loss of motor power, or of co-ordination. He is a very muscular man, both knee-jerks brisk and equal, no ankle clonus; the left great toe shows a definite tendency to extension; the right goes definitely down. There is no ptosis or ocular paralysis, no nystagmus; the face is normal; the tongue is not tremulous. Optic disks and fundi normal. Sphincters—he passed water in the bed on admission, but rapidly improved as soon as the mental state cleared up.

Mental state. On admission he was semicomatose, and when aroused he became violent. He was always more restless at night; there are no hallucinations, no illusions, no obvious emotional disturbance. His memory has been bad lately, and has been entirely destroyed for the whole of the present illness. He does not remember coming into the hospital; he remembers trying 'to get out'.

A few days after admission the delirious state with purposeless motile restlessness began to clear, and his memory for recent events improved, so that at the end of a week the notes state 'that he answered questions quite sensibly, and his mental state seems to have cleared up'. He was discharged on December 12th, 1901.

Diagnosis and summary. Syphilitic cerebral endarteritis. Comatose on admission. On discharge no physical signs. He attended as an out-patient for some time and after two months, as he improved so much, he neglected to go any more. The wife informed me that for the last six months he has been a changed man; he complained of severe headache, worse at night; there was no vomiting; waking, irritable restless states alternated with sleepy drowsy states; for years he has been unable to do any proper work; he took no interest in anything; he had no delusions; he was a kind, affectionate husband, and up to three months ago the sexual relations were normal, since then he has been impotent. She has been married to him eight years, and had had good health. Since he came out of the hospital six years ago, he had been having fits; he did not lose consciousness, 'but saliva dripped from the mouth, and he lost his speech.' He was worse after a fit. He was again admitted to the London Hospital, transferred after a few days to the infirmary, and sent from the infirmary to the asylum.

His state on admission to the asylum was thus described in the notes. Heart and lungs apparently healthy. Pupils irregular and react sluggishly to light. The knee-jerks are exaggerated, ankle clonus and Babinski sign obtained. 'Speech slurred and at times like a general paralytic. He is extremely confused, no idea of time, nor has he any idea of where he is or how long he has been here. He is incoherent and rambling. Cerebral tumour.' A week later the case was diagnosed as epileptic dementia on account of the fits he was having.

July 9, 1908. The notes state he has marked rigidity of the left arm, leg, and side of body, with weakness of muscles of right side of face, and difficulty of swallowing. No rise of temperature.

July 16, 1908. 'He is, if anything, better this morning; his respirations at times are slow and regular, at others quick and laboured, and Cheyne-Stokes breathing is no doubt indicated here. The next day he died. At the autopsy old basic syphilitic meningitis with universal syphilitic endarteritis cerebri was found. The whole of the cerebral vessels were affected by an endarteritis. All the arteries forming the circle of Willis show nodular or general thickening of their walls, the small arterial branches universally have the feeling and appearance of fiddle-strings, and when cut their walls are obviously so much thickened as to partially or completely obliterate the lumen. The pia arachnoid about the base of the brain is obviously thickened, due to old meningitis. There is recent softening in both hemispheres, affecting especially the upper portion of the prefrontal and frontal regions, and corresponding with the distribution of the anterior cerebral arteries which are thickened and occluded by endarteritis and thrombosis. The weight of the brain is 1,385 grams, but the pons, cerebellum, and medulla weigh together only 145 grams, instead of 175–180 grams; no doubt this loss of weight can be accounted for by the basic meningitis and arteritis which the patient suffered from six years previously. The fourth ventricle was granular throughout. The aorta was free from atheroma except for an elongated pearly fibrous plaque just above the bifurcation.

Microscopic examination revealed the typical appearances of syphilitic endarteritis. It is doubtful whether antisyphilitic remedies could at this stage have afforded any relief or averted the fatal termination which was doubtless due to failure of the respiratory centre.

EPILEPTIC FITS MAY BE THE RESULT OF ORGANIC DISEASE NEAR, BUT NOT SITUATED IN THE MOTOR AREA

Patches of softening, either in the anterior part of the capsule or in the frontal region of the brain, may cause irritation of the adjacent motor area and give rise to epileptiform fits, which afterwards become generalized and even indistinguishable from true epilepsy. I have seen a considerable number of such cases in the asylums, and they are frequently diagnosed as epileptics. The following is an interesting example:

CASE 20. W. W., aged 32. Farm bailiff. Married eight years, four children. Contracted syphilis at 13 years of age, sore throat and rash, was treated for two years; children all healthy. Habits temperate, no epilepsy or insanity in family. Six years ago, that is eleven years after infection, while at work, he had a fit and lost consciousness. For some time previously he had *suffered from transitory attacks of loss of memory for words*, knowing what things were, but unable to name them. After the fit his speech was thick; then he had several more fits, after which he had a hemiparesis. About this time he suffered with headache, which was worse at night. He has now no paralysis or aphasia, but for five years past he has suffered with fits, three or four a day, sometimes only one or two a week. Description of fits by his wife: Both cheeks became flushed and he complained of dimness of sight some hours before. The fit began by conjugate deviation of head and eyes to the left, he made a gurgling in the throat followed by tonic spasm in all the limbs, the arms were extended and the fingers clenched in the palm. No clonic spasms followed; he then breathed deeply and awoke.

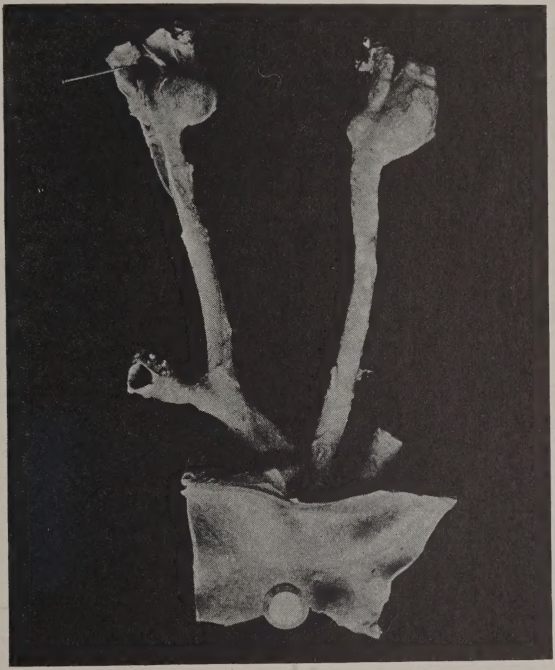


FIG. 8. A portion of the arch of the aorta, showing the two common carotids with an aneurysm just above the bifurcation on each side, about the size of a filbert.

ANEURYSM, RUPTURE, CEREBRAL HAEMORRHAGE

Rupture of the large vessels apart from aneurysm so rarely occurs in syphilitic arteritis that it is unnecessary to discuss the symptomatology. Small haemorrhages into the sheaths of the vessels, into the substance of the brain and the meninges may occur, but as a rule, they cannot be correlated with any definite clinical symptoms. Aneurysms may give rise to haemorrhage, and they owe their origin frequently to syphilitic arteritis. An interesting case of multiple aneurysms of syphilitic origin was the following.

CASE 21. Male, aged 38 years. Admitted to Claybury Asylum, February 10, 1903, under the following certificate; patient is prematurely aged—he looks 60. Appears to be suffering from softening of the brain and subject to what may be termed melancholic stupor; he is certainly irresponsible and unfit to be at large. His wife states that during the night he will use most obscene language, calling her a whore; this is unnatural to him. He neglects his person and is sometimes violent. The illness commenced eight months previously and he has got worse. There was a history of syphilis, but when is not stated. There was a history of an aunt on the father's side having been insane. After admission to the asylum he was regarded as a general paralytic from the fact that the speech was slurred, the pupils unequal and the deep reflexes

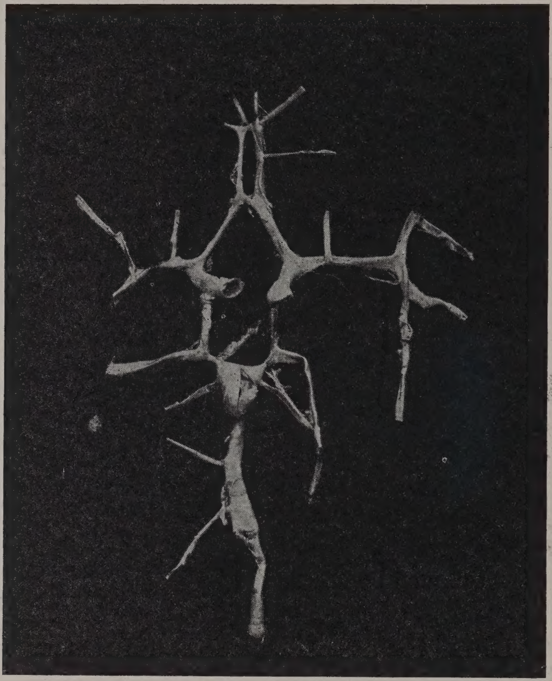


FIG. 9. Multiple aneurysms on the arteries of the circle of Willis, with general nodular endarteritis of all the vessels.

exaggerated. Mentally he was confused, had little knowledge of time and place, and he had at first delusions of persecution. Later he developed marked grandiose delusions. He died eleven months after admission from cardiac failure due to thrombosis of the left coronary artery. At the autopsy there were found two aneurysms the size of large filberts, affecting both common carotids at their bifurcation, and multiple aneurysmal dilatations on the basilar and middle cerebrals; there was besides a general universal nodular endarteritis of all the cerebral vessels with multiple softenings in the basal ganglia, prefrontal and fronto-parietal regions (vide Figs. 8 and 9).

Although there was some granulation of the ependyma of the ventricles and thickening of the pia-arachnoid over the frontal and fronto-parietal regions, microscopic examination did not show the characteristic appearances of general paralysis, but of universal syphilitic endarteritis. It was one of those cases which some authorities call syphilitic general paralysis; a better term is pseudo-general paralysis.

Another case of probable syphilitic origin which came under my notice at Hanwell Asylum was the following: A middle-aged woman, who had long been insane, died quite suddenly during a struggle with an attendant. During life it had been noted that she had unilateral paralysis of the third nerve. I suggested that we should find an aneurysm at the autopsy which had ruptured causing death. This was the case, an aneurysm the size of a large filbert was found at the junction of the posterior communicating and posterior cerebral artery which was pressing upon the third nerve at its origin.

The existence of the oculo-motor paralysis had led to a diagnosis of probable syphilitic brain disease, but that the paralysis was caused by compression of an aneurysm was not anticipated until the sudden death occurred.

An aneurysm of the basilar artery can, as is seen in Fig. 10, produce compression of important nervous structures in the brain including the cranial nerves, and become spontaneously cured, although of the size of a large filbert. The following is a brief record of this case.

Case 22. R. B., aged 47 years, admitted to Claybury Asylum suffering with epileptic fits, delusions of persecution and hallucinations of vision and hearing. The case was one of post-syphilitic, right hemiplegia, epileptic dementia, and drink. A year later the effects of the alcohol had passed off and he was certified as suffering from epileptic dementia. His answers now were fairly clear, his mental reaction was slow, and his reasoning power was poor. No hallucinations or delusions were recorded. He died later of institutional dysentery. A history obtained from relatives showed that he had a fit when *he was* 17 *years of age*, and this left him paralysed on the right side. He had previously, even at this early age, led a very fast life with loose women. *Autopsy.* Syphilitic scars on penis and on various parts of the body. On the basilar artery there is an aneurysm the size of a filbert projecting to the left and making a small indentation into the pons. The tumour had several small yellow nodules in its walls. On cutting it through, it was seen to be filled with an organized dense fibrous substance, which grated on being cut and contained a considerable amount of calcareous matter. The aneurysm had been formed by a bulging out of the left side of the artery. The vessel itself was unaffected for two-thirds of its circumference, so that the lumen of the vessel was not seriously affected. The aneurysm may be said to have undergone a cure. This may have caused the persistence of the right-sided hemiplegia, but the original fit followed by hemiplegia, and the fits and dementia which the patient suffered from, were no doubt due to the atrophic sclerosis found at the base of the inferior frontal convolution, the anterior part of the gyrus fornicatus and the subjacent white matter. Atrophic sclerosis was also found in the anterior portion of the internal capsule in front of the genu of the left hemisphere. There was also some atrophy and sclerosis of the lenticular nucleus. There were no lesions in the right hemisphere. The vessels were all thickened. There was naked eye sclerosis in the crossed pyramidal tract of the cord. There can be no doubt that this was a case of universal syphilitic arteritis and softening occurring in a youth, and that the aneurysm was due to a patch of arteritis yielding to the pressure, but that a spontaneous cure had occurred, which is remarkable, seeing that the man was an epileptic and apparently had no treatment of a systematic nature for syphilis. If he had not taken to drink it is probable that he would never have come to the asylum; although it is probable he would, in any case have developed epilepsy and a certain degree of mental enfeeblement, yet the mental symptoms which brought him to the asylum were, as the notes show, mainly the result of alcohol upon a damaged brain.

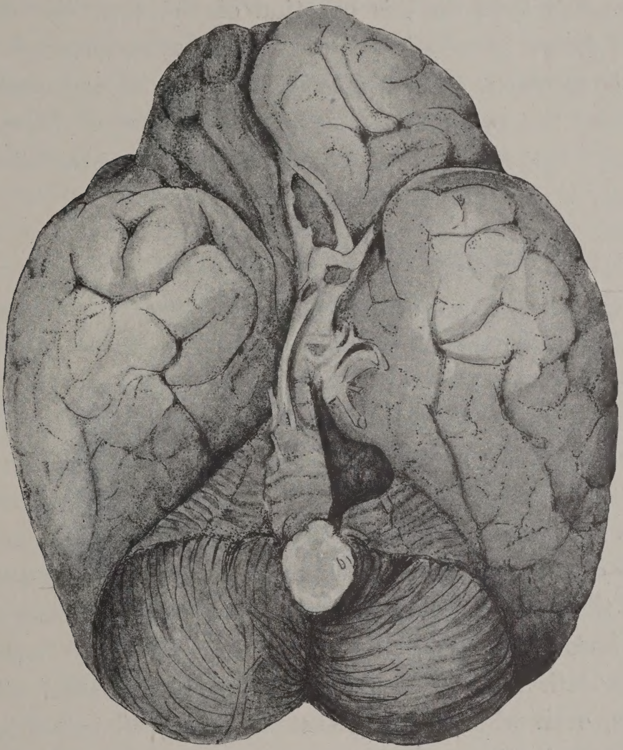


FIG. 10. A healed aneurysm of the basilar artery occurring in a case of syphilitic arteritis.

Relation of syphilitic endarteritis to arterio-sclerosis. In the pathological section the condition of the arteries in old cases of syphilitic brain disease and their relation to atheroma and arterio-sclerosis has been discussed, but I may say that a large experience and a careful attention to the subject has convinced me that syphilis plays a very important part in the production of atheroma and endarteritis deformans of the nodular character (Heller's aortitis) as distinguished from arterio-sclerosis, where there is a universal thickening of the endarterium secondary aud compensatory to weakening of the muscular and elastic coats from stress and toxic action. The Wasserman method of testing the serum and cerebro-spinal fluid described on p. 206 will doubtless throw much light on this question of the syphilitic origin of certain forms of arterio-sclerosis. The symptoms of arterio-sclerosis occurring in persons past 50 years of age resemble in some way the symptoms of general paralysis or of syphilitic arteritis. This question will be fully dealt with in the chapter on diagnosis of syphilitic brain disease.

Cerebro-spinal Meningitis

Nearly all the cases of basic syphilitic meningitis which I have carefully examined with the microscope have shown that the inflammation has extended to the spinal cord ; in many instances to the extreme end of the spinal canal, but owing to the fact that the cerebral symptoms were so severe and intense the spinal symptoms were either overshadowed, or the patient was not in a fit state to express his subjective feelings and thus afford the necessary proof of their existence. If, in a case of basic meningitis, besides stiffness of the neck, there existed stiffness of the limbs and absence of the knee-jerks, one would expect that the spinal membranes were also affected. Again, when we speak of spinal meningo-myelitis, even when the lesions point to a focal spinal lesion, a careful examination and consideration of the symptoms afforded by a reliable history will often show that the base of the brain was also affected.

Recent observations have shown that even in such an apparently localised disease as anterior poliomyelitis, there is always a general inflammation of the spinal meninges and the pial septa. Probably in all cases of syphilitic meningitis in which the obtrusive symptoms are focal, we should, by microscopic examination, find some degree of inflammatory change from the base of the brain to the end of the spinal canal. That is to say, there is a generalized infection, although the inflammatory reaction may only be intense enough in one region to give rise to definite symptoms. Some cases of meningo-myelitis may exhibit functional disturbance of the eye muscles, affection of the optic nerves or tract; an apoplectic attack, or psychical disturbances are signs indicating cerebral participation. Sometimes again the disease presents the clinical picture of a *transverse myelitis*, at others of a *tabes dorsalis* or *pseudo-tabes*. A careful examination and history of many of these spinal cases will reveal the fact that the brain has suffered in some way or other. In the diagnosis, signs pointing to spinal meningeal and root irritation are especially significant when followed by anaesthesia or hyperaesthesia and atrophic paresis. Great variations, remissions, exacerbations, and intermissions may be observed in the course the disease runs. The following was a case which began with cerebral symptoms, but in which the spinal symptoms caused the patient to seek relief at the hospital.

CASE 23. A. P., aged 25 years, policeman, was admitted to Charing Cross Hospital under my care. Syphilis twelve months ago, primary sore followed by diffuse syphilitic eruption ; he had been treated for this with mercury and iodide of potassium ever since the commencement of his illness. He felt well in health until four months ago, when the rash broke out more copiously than before, and he suffered with frontal and occipital *headache* of a dull aching character, much worse at night. At the same time he became very tremulous in the hands and legs, especially noticed after slight exertion. Difficulty in walking showed itself in a tendency to swaying. Five weeks before admission he first noticed a girdle sensation about the level of the umbilicus, then he observed a pain in the calves of a cramp-like character. Two weeks later he found a little difficulty in micturition and his bowels became constipated. There were no other symptoms. He never had diplopia, impairment of vision, or weakness of memory.

Present state. Well-developed healthy man, temperate in habits. Slight muscular enfeeblement in arms and legs, no apparent wasting. Gait spastic, walks with a wide base. Knee-jerks very exaggerated on both sides, patellar and ankle clonus easily obtained. Plantar extensor reflex present both sides. Cremasteric reflexes sluggish. *Epigastric and abdominal reflexes* *absent.* Wrist tap and triceps reflex exaggerated. Pupils unequal, slightly dilated, the right a little the larger.

Sensory. Slight patchy hypalgesia over thighs and upper part of legs, a more marked hypalgesia over the feet, a belt of hypalgesia over the trunk corresponding to seventh, eighth, and ninth segments, and also over the skin area corresponding to lowest sacral and coccygeal roots (vide Fig. 11). No anaesthesia.

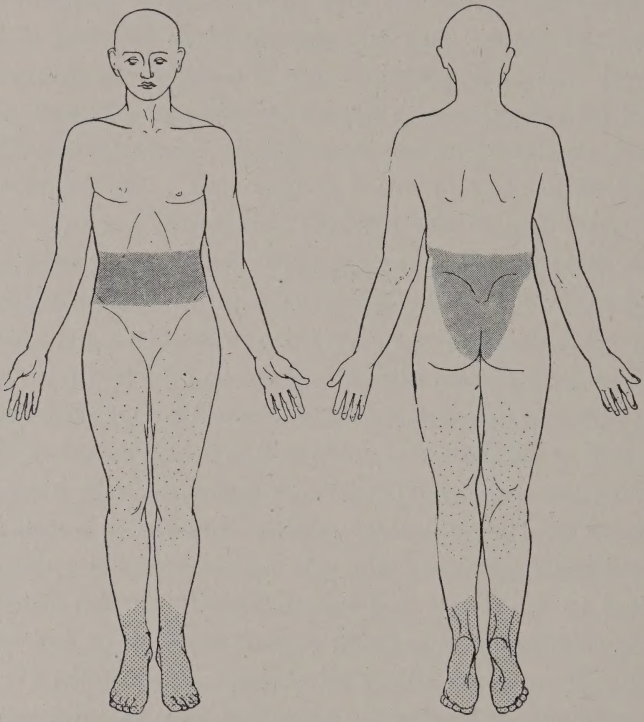


FIG. 11. Diagram showing distribution of sensory disturbances.

The symptoms of spinal meningitis, however, will be considered later ; but there are certain symptoms which point to a diffuse cerebro-spinal meningitis. In addition to the symptoms of basal meningitis already referred to, we may have spinal symptoms, namely, pain and stiffness in the back, radiating pains owing to the affection of the spinal posterior roots, girdle sensation and hyperaesthesia of the skin, and if the patient lives long enough, an atrophic paralysis due to involvement of the anterior roots. But the somnolent condition of basal meningitis renders it difficult to find out these spinal symptoms. Moreover, loss of control of the sphincters may occur from cerebral affection, but of course, if there is not much cerebral disturbance, as in the case just described, the sphincter troubles are obviously due to the spinal disease. Fever is either absent or anomalous in character.

The following is a short account of a typical case of acute cerebro-spinal meningitis with extensive endarteritis. Death from pneumonia thirty-seven days after the onset of symptoms.

Case 24. Male, aged 34 years, occupation, fish porter, formerly a soldier who had served in India. Admitted to Claybury Asylum, July 8, 1897; died July 20, 1897. Certified as suffering from hemiplegic dementia.

History from mother. Twenty-five days ago her son came home from his work complaining of pain in the neck and back of the head and stiffness in the neck. He was violently sick for two days. Mother thought it was due to intemperance, for upon the day he was incapacitated he had taken nineteen pots of beer. She thought he had delirium tremens, for he had hallucinations and delusions.

On admission, syphilitic scars on various parts of the body were noted. He was hemiplegic and had difficulty in swallowing. There was nystagmus. He lay in bed helpless, with a vacant expression, in a somnolent dreamy state. He was demented, dazed and confused, and took a long time to answer questions, but could give his name in a drawling, heedless manner. A few days later marked retraction of the head and neck, stiffness of limbs and opisthotonos occurred, followed by coma and death. He was certified as dying from syphilitic meningitis and pneumonia.

Macroscopic examination exhibited cerebro-spinal meningitis and general endarteritis of the brain and spinal cord. Microscopic examination showed an infiltration with embryonic cells of the whole of the membranes of the base of the brain and the spinal cord. This infiltration extended along all the pial sheaths into the substance of the brain and spinal cord and into the cranial nerves, also into the anterior and posterior roots of the spinal cord (vide Plate XIV), and the posterior spinal ganglia. There was a general periarteritis and endarteritis; the walls of the veins were affected similarly to the arteries ; it was remarkable how unequally the vessels were affected ; for upon microscopic examination of sections two divided vessels might be seen side by side, one with the coats densely infiltrated with lymphocytes and plasma cells, the other hardly at all (vide Fig. 12). Moreover

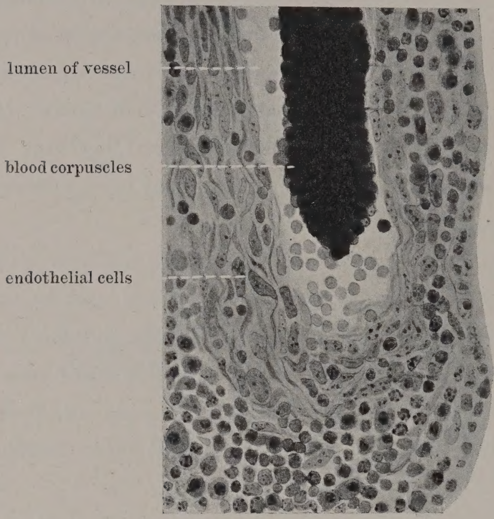


Fig. 12. A section of the wall of a vessel, from the specimen shown in Plate XIV, in which is seen a dense infiltration with lymphocytes and plasma cells. Magnification, 300 diameters.

the infiltration was often nodular, as if the irritating *virus* had either escaped from the blood-stream or gained access to the lymphatic clefts of the wall of the blood-vessel, and set up there a formative hyperplasia. The basilar artery was almost obliterated. Cultures obtained from the membrane in broth, gelatine, and agar remained sterile.

PLATE XIV.

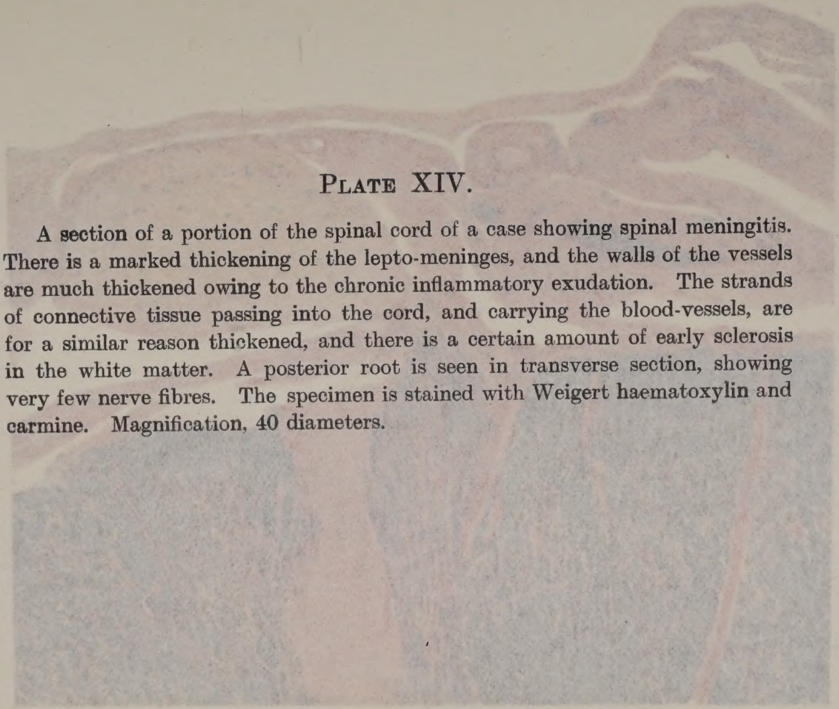


PLATE XIV.

A section of a portion of the spinal cord of a case showing spinal meningitis. There is a marked thickening of the lepto-meninges, and the walls of the vessels are much thickened owing to the chronic inflammatory exudation. The strands of connective tissue passing into the cord, and carrying the blood-vessels, are for a similar reason thickened, and there is a certain amount of early sclerosis in the white matter. A posterior root is seen in transverse section, showing very few nerve fibres. The specimen is stained with Weigert haematoxylin and carmine. Magnification, 40 diameters.

To face p. 114.]

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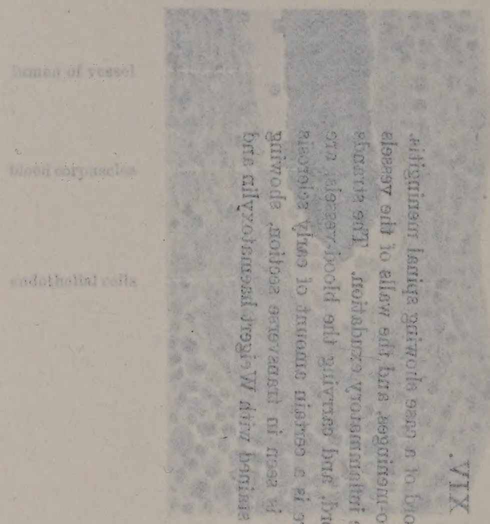

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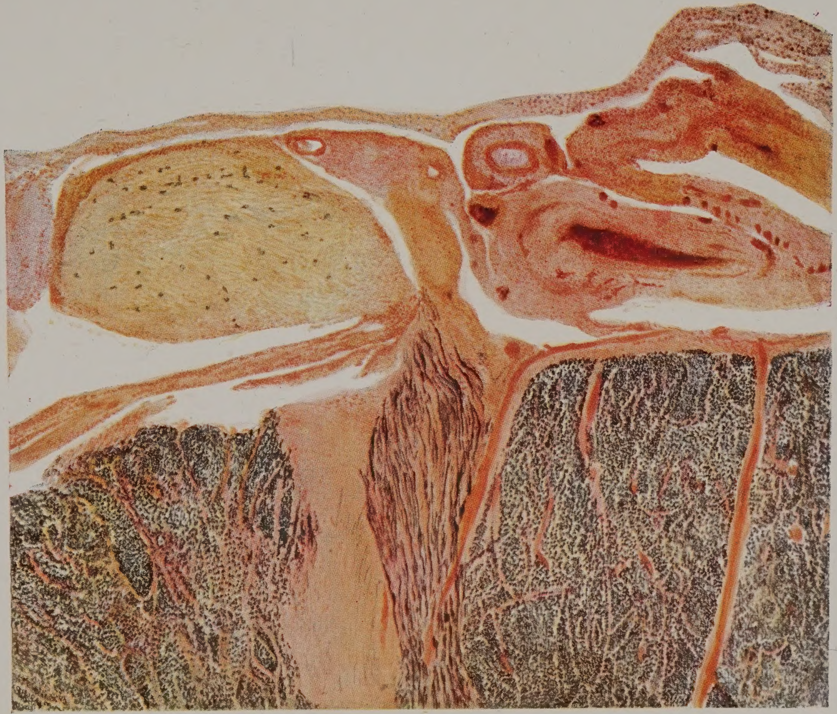
PLATE XIV.



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CHAPTER IV

SYPHILIS OF THE SPINAL CORD

Introduction

In discussing the subject of cerebro-spinal syphilis reference was made to the fact that basic syphilitic meningitis never occurs without the process in some degree affecting the spinal membranes. It is also true that in the majority of cases of spinal syphilitic meningitis the membranes at the base of the brain are simultaneously affected, but often so slightly as not to cause obtrusive symptoms. Again, on several occasions, it has been pointed out (and cases have been cited) that symptoms of syphilitic meningitis, spinal and cerebral, have been concomitant with a syphilitic eruptive fever; so much so, that syphilitic meningitis might almost be considered as an eruption affecting the meninges and caused in the same manner as the skin eruption.

But just as the skin eruption may occur at any period from three months onwards, so a syphilitic meningitis may occur at any period after infection. With our better knowledge of the cause of syphilis and the similarity of the histological characters of the lesions at all stages of the disease, we are coming to accept the dictum of Wilks enunciated in 1867. 'The term tertiary syphilis is objectionable; there is no real distinction between the primary, secondary, and tertiary forms.'

The Relation of Syphilitic Eruption to Recognized and Unrecognized Syphilosis of the Meninges

Many cases of syphilis of the meninges could be cited where the symptoms have appeared within three months of the primary infection; e. g. in one of the cases recorded by Goldflam. A strong man of 40, one month after the appearance of an indurated chancre, was seized with violent pains in the neck, the shoulders, and upper limbs, with stiffness and immobility of the limbs. There was also a marked hyperaesthesia in the area supplied by the brachial plexus ; the case was completely cured after twenty-four inunctions.

It is probable that, as Lang suggests, many mild cases may be overlooked and possibly the paraesthesiae and pains in the limbs, with incapacity for work during the eruptive period on the skin, may be due to a hyperaemia and slight cell infiltration of the membranes, which may disappear like the skin eruption with antisyphilitic treatment. Under unfavourable conditions, such as a chill or trauma or secondary microbial infection, these slight meningeal changes may proceed to meningitis and meningomyelitis.

Jarisch called attention to the increased superficial and deep reflexes in recent syphilis. Finger also noted this before and during the eruption of the exanthem ; soon to be followed by a lowering of the reflex excitability below the normal, and in some cases a disappearance. Moreover Fournier observed in the beginning of the secondary period a regional analgesia, ‘Analgésie syphilitique secondaire,’ attributable to the same cause, and Schnabel claims to have found a hyperaemia of the fundus in the commencement of the secondary period in a great number of cases of syphilis. Max Nonne, after referring to these observations, remarks that these signs and symptoms are insufficient to warrant the hypothesis in the absence of any anatomical proof. Sir Wm. Gowers, in his Lettsomian lectures, 1890, scathingly criticized the evidence brought forward to show that a slight meningitis may be associated with the early phenomena of syphilis more frequently than is generally supposed. But the researches of Ravaut and others show the frequent existence of a lymphocytosis during the secondary period, sometimes very abundant, which proves that there may be a meningeal reaction concomitant to the cutaneous eruption. A series of observations of lymphocytosis of the cerebrospinal fluid of early cases of syphilis, in which there occurred slight signs of meningeal irritation, and a parallelism between the abundance of lymphocytes and the intensity of the signs of meningeal irritation both diminishing and disappearing on treatment would substantiate Lange's hypothesis. Boidin and Pierre Weil point out that the study of the cerebro-spinal fluid shows that the central nervous system is very frequently affected in the secondary period, but this affection may *only* be *habitually* shown by the cellular reaction of the meninges and is sometimes associated with ocular troubles or paralysis of cranial nerves or other objective signs; it is exceptional, however, for signs of acute meningitis to occur.

'They describe the case of a young man of 18, admitted to the hospital with all the signs of an acute meningitis, headache, vomiting, constipation, rigidity of neck, Kernig's sign, inequality of pupils and slight elevation of temperature. The first impression was that it was a case of tubercular meningitis; but upon examination of the patient, the existence of an indurated chancre of the penis was discovered. No other specific sign was found, no mucous plaques, no roseola, no sub-occipital adenopathy. Lumbar puncture revealed a pure lymphocytosis of average intensity. Four days later the roseola appeared. This patient rapidly recovered under treatment, and the following is a chronology of the symptoms: (1) chancre, middle of June; (2) headache, July 15; (3) signs of meningitis, August 5; (4) roseola, August 12; (5) cure of the meningitis, August 17.'

Moreover, it is permissible to consider that late manifestations may in some cases be the result of secondary lesions which have remained *latent* until roused into activity by some exciting factor, such as exposure to cold, trauma, microbial toxaemia, or alcoholism. For there is no period after infection in which syphilitic meningitis may not occur; in a case of Williamson's twenty-seven years elapsed, and in one of Max Nonne's twenty-four years. On p. 437 I have recorded a case of congenital syphilitic cerebro-spinal meningitis occurring in an undeveloped girl of 17, the subject of congenital syphilis.

ETIOLOGY

Frequency. According to my experience spinal syphilis is not so common as cerebral syphilis, and not nearly so common as *tabes dorsalis.* Williamson gives the records of the Manchester Royal Infirmary for ten years as follows :

No. of medical in-patients in ten years.	*No. of cases of nervous diseases.*	*No. of cases of tabes dorsalis.*	*No. of cases of spinal syphilis.*
14,575	2,456	118	32

Boulloche found in an analysis of 1,085 cases of syphilis of the nervous system, mostly under the care of Fournier, that there were 77 cases of spinal and 416 of cerebro-spinal syphilis. It is probable that these statistics of spinal syphilis include a number of cases in which the cerebral symptoms were very slight and transitory, and therefore of little clinical significance or importance. Williamson states that slight or temporary cerebral symptoms, e. g. headache, diplopia, or strabismus, occurred in 11 out of 31 of his cases.

ONSET OF SPINAL CORD DISEASE IN RELATION TO PERIOD OF INFECTION

According to my experience the majority of cases of spinal syphilis occur within the first three years after infection. Of 12 cases which I have had under observation in the hospital, only 4 were over three years, 5 were two years or under (vide Cases 2 and 23, pp. 11 and 117), and 2 within three years after infection. Hutchinson states that one-half of his cases occurred within eighteen months of infection. Of 44 cases of Gilbert and Lion, quite a number occurred between three and six months of infection. Magnus Möller relates 5 cases, all of which occurred within two years. Of Goldflam's 18 cases, 4 occurred in the first half year; in the second six months, 2 cases; after one year, 3 cases; in the course of the second year, 4 cases; more than two years after infection, 5 cases. Of Williamson's 27 cases, more than one-half occurred during the first five years. Boulloche found that 62 per cent. of 71 cases occurred during the first five years.

Sex. Strange to say, all the cases which I have seen (with one exception not included in the before-mentioned cases) were males. Amongst Williamson's 31 cases, 26 were males and 5 females. Sottas gives the proportion of 1 female to 10 males. It is undoubted that syphilis is much more common in males than females, but this fact alone will not account for the disparity in the sex incidence of spinal disease of syphilitic origin.

Age. The average age of the onset of symptoms of my 12 cases was 27. Only 1 of the patients was over 30 years of age at the onset of symptoms ; the average age at which infection occurred was 23. This gives four years as the average time elapsing between infection and onset of symptoms, thus there is a marked difference to tabes dorsalis, where the average time is ten years. The following case is of considerable interest on account of reinfection giving rise to spinal meningitis.

A man was admitted to Charing Cross Hospital under my care, who, thirty years previously, had suffered with chancre, sore throat, and rash ; and was reinfected sixteen months ago. He again had a chancre, rash, and sore throat. Within twelve months of infection he suffered with girdle pain, on the left side, absence of abdominal reflex, and some root anaesthesia on this side, increase of the deep reflexes and slight Babinski's sign on this side, together with inability to empty the bladder. He had a papular rash on admission and a general polyadenitis. There was a lymphocytosis, not marked, of the cerebro-spinal fluid. He improved rapidly on mercurial inunction. The rash rapidly cleared up and the cord symptoms also. The case therefore was a localised syphilitic meningitis due to the reinfection.

Relation to nature of infection and treatment. Authorities are generally agreed that syphilitic meningitis may follow both mild and severe attacks of syphilis. Some of my patients were cases in which the primary sore was a chancroid ; others were cases of typical Hunterian chancre. This is not surprising, seeing that Levaditi has shown that the tissues are crowded with spirochaetes before there are any naked-eye signs of induration. All the cases but two, however, had signs of syphilitic residua in the form of enlarged glands, papery scars, and skin eruptions, &c., contrasting thus remarkably with the generality of cases of tabes and general paresis. It was noticeable that more than one half of the cases had been thoroughly treated with mercury, and several were taking mercury at the time the symptoms came on. Gajkiewicz reports a case in which the symptoms appeared during inunction treatment. Still, it is certain that there is a *much* greater liability to syphilis of the nervous system in those who have either not been treated or only inadequately treated in the early stages, however we may choose to explain the pathogenesis of the lesions (vide p. 10).

Predisposing causes. Occasionally injury (vide p. 11) to the back, exposure to cold, and immersion may apparently induce the onset. One of my cases was a young fireman who had been drenched for a long time on a wintry night, and a few days after he lost the use of his legs. Still, too much importance must not be attached to these predisposing causes, or the essential cause and its effectual treatment may be overlooked. Chronic alcoholism is a potent cause inducing the onset of all forms of syphilis of the nervous system; likewise occasional excesses *in baccho et venere.*

There is no question that Dr. Buzzard was right when he asserted that a very large proportion of the cases of spinal paralysis occurring in adult males under 30 are of syphilitic origin, and the paralysis may be due to various lesions which will now be further considered by a study of the morbid anatomy and pathology.

BRIEF HISTORICAL SUMMARY OF THE EVOLUTION OF OUR KNOWLEDGE OF THE PATHOLOGY OF SYPHILIS OF THE SPINAL CORD.

The older authorities in the first half of the last century only recognized diseases of the spinal cord due to syphilitic affections of the vertebrae, and they attributed the syphilitic diseases of the spinal cord which were cured to exostosis or periostitis of the vertebrae causing compression which had undergone resorption under treatment.

> 'The insufficiency of the osseous theory to explain the vast majority of cases of syphilitic paraplegia was insisted upon by Gier (1857), Lagneau (1860), Steenberg (1861), and Zambaco

(1864), and the last-named published in his work an observation of *gumma of the meninges*, also MacDowall (1861), Wilks (1863), and Wagner (1863). Moxon, in 1871, first *described gummata of the spinal cord*; Bruberger (1874) and Eisenlohr (1884) gave the first observations of pachymeningitis syphilitica without osseous alterations.' Cornil and Ranvier.

Although *syphilitic myelitis* is now recognized as a relatively common affection of the nervous system, it had in only comparatively few instances been systematically investigated by microscopic examination before the memoir of Charcot and Gombault (1873), in which is fully described a case of disseminated syphilitic lesions of the nervous system.

'Since then publication of investigations have innumerably multiplied, Hayem (1874), Homolle (1876), Julliard (1879), Strümpell (1880), Savard (1882), Dejerine (1884), have described the different forms of syphilitic myelitis, and to these observations, together with those of Gilbert and Lion, Lamy and Sottas, we owe much of our present knowledge of the pathology of the subject.' Cornil and Ranvier.

Westphal, studying the relations of syphilis and tabes, insisted upon the lesions of the vessels in this disease. But it was Greiff (1882) who first called attention to the fact that not only was there an *endarteritis* and *periarteritis*, but that there was also an *endophlebitis* and *periphlebitis* in spinal syphilis. Schmaus, in 1888, called attention to a diffuse *syphilitic arteritis and poliomyelitis*. But already Fagge, in 1885, had alluded to a fatal case of myelitis under the care of Dr. Wilks, in which he found a marked endarteritis, and he expressed the opinion that many cases of *syphilitic myelitis* may be due to *arterial changes*, similar to those described by Heubner in the cerebral vessels. Möller and Siemerling (1891) showed that there was a preponderance of the *venous lesions in syphilitic meningitis*, and Lancereaux, Dejerine, and Sottas taught that *myelitis* is due to *softenings caused by circulatory troubles*, by ischaemia consecutive to endarteritis, or, according to Sottas, to blood stasis caused by venous obstruction, thus accounting for the sudden symptoms arising in acute *syphilitic paraplegia*. The above summary is that given in the last edition of Cornil and Ranvier's pathology, slightly modified. No reference, however, is made to the work of Jürgens, who especially called attention to the participation of *the lymphatics in syphilis of the spinal cord.* In the light of our present knowledge of syphilitic processes it is probable that the lymphatics play a very important part in the pathogenesis of spinal syphilis. Again, it is necessary to mention that in 1892 Erb described a class of cases of *chronic spinal syphilis* presenting a group of symptoms which he believed formed a common and distinct clinical variety. Oppenheim, with whom I am inclined to agree, admits the frequency of the group of symptoms described by Erb, but he believes they are merely cases of syphilitic meningo-myelitis occurring in the dorsal region, and that Erb's syphilitic spinal paralysis is not a disease *sui generis.*

THE RELATION OF THE MORBID ANATOMY OF SYPHILIS OF THE SPINAL CORD TO THE CLINICAL FORMS

The evolution of our knowledge of the morbid anatomy of spinal syphilis and the correlation of the symptoms manifested during life with the changes found post mortem, have, we observe, led to the recognition of various forms of spinal syphilis which may be classified as follows: (1) Syphilitic disease of the vertebrae. (2) Chronic syphilitic meningitis; (*a*) chronic pachymeningitis; (*b*) chronic leptomeningitis, or both may be combined. (3) Meningo-myelitis, a leptomeningitis often localised with invasion of the cord. (4) Paraplegia of acute onset, so-called acute syphilitic myelitis; for the most part this is due to softening caused by vascular disease. (5) Chronic syphilitic spinal paralysis, Erb's paralysis, but whether this really differs from meningo-myelitis dorsalis is doubted by many. (6) Meningeal and intramedullary gummatous tumour. (7) Gummatous infiltration of the roots of the cauda equina. (8) Various anomalous forms simulating other nervous diseases, e.g. *pseudo-tabes.*

In all these forms of disease the nervous elements suffer secondarily to morbid processes affecting the enclosing, supporting, and nutrient vascular tissues of the spinal cord and the roots. The virus may attack primarily the bones, the membranes, or the vessels; leaving out of account the vertebrae, which are very rarely the seat of the disease, it is seldom that the membranes and nutrient vessels are affected independently. Both are affected simultaneously, although it may be with unequal intensity and extension. The symptoms largely depend upon the affection of the vessels, both arteries, veins, and lymphatics, and naturally vary according to the portion of the cord in which the inflammatory process is most intense ; later on, reasons are given why certain regions of the spinal cord are more frequently affected than others. Although spinal syphilis may resemble many other diseases of the cord, yet apart from the history of syphilis or the existence of signs on the body there are groups of symptoms in many of the above clinical forms which of themselves are suggestive of syphilitic origin.

When a case of disease of the spinal cord presents itself we should ask ourselves the following questions :—

1. Is the process thus indicated by the signs and symptoms one of the above clinical forms of syphilitic spinal disease ?
2. Can any cause other than syphilis be traced ?
3. Does lumbar puncture show the existence of lymphocytes or polymorphonuclear leucocytes in the cerebro-spinal fluid ?
4. What is the seat of the lesion as indicated by the affection of roots or segments of the spinal cord, and what is the nature of the lesion as shown by the symptoms and course of the disease ?
5. Does the blood and cerebro-spinal fluid give the Wassermann reaction ?
6. Lastly and subsequently, does the result of treatment confirm our conclusions ?

SYPHILITIC DISEASE OF THE VERTEBRAE

Although syphilis frequently causes disease of bones, yet it comparatively *very* rarely gives rise to disease of the vertebrae. When syphilitic lesions produce osseous deformities and caries of the vertebrae, a *pachymeningitis* may arise and grave lesions of the spinal cord may ensue.

Syphilitic osteitis of the vertebrae may occur alone, or in conjunction with disease of the cranial or other bones. There are relatively few cases of syphilitic disease of the vertebrae on record, and those are mainly by the older writers. ‘ In some of these cases there were no signs characteristic of syphilitic disease and the diagnosis was based (1) on evidences of disease of the vertebrae occurring in patients who had had syphilis ; (2) on the improvement under antisyphilitic treatment. It is possible that some of them have been cases of ordinary tubercular caries in persons having a syphilitic history. In other cases, however, there have been indications of the syphilitic nature of the vertebral disease, or an autopsy has shown the diagnosis of syphilitic disease to be correct ' (Williamson). The following forms of syphilitic disease of the vertebrae have been described, (1) syphilitic osteitis ; (2) syphilitic periostitis ; (3) syphilitic exostoses and periostosis ; (4) gummata in the bone or on the surface ; (5) syphilitic caries ; (6) syphilitic necrosis.

The disease may arise by direct extension from the bones of the skull to the spinal column ; or it may arise from the direct extension of syphilitic ulceration of the throat to the cervical vertebrae. Gerhardt cites a remarkable case of Hobbs in which the posterior wall of the pharynx was destroyed by ulceration and a caries of the cervical vertebrae ensued ; a sequestrum could be felt with the finger, and if this were pressed upon, a transitory unilateral paralysis ensued ; later unilateral choreiform spasms occurred. Again, Leyden and Goldscheider quote a case recorded by Autenreith of a man aged 20, who suffered from syphilitic ulceration of the fauces. The destruction of the vertebrae was such as to expose the spinal dura mater, so that it could be seen through the mouth. It was found after death that the anterior arch of the atlas was destroyed, and the odontoid process involved in the disease.

Syphilitic exostoses of the vertebrae have been recorded, and two remarkable cases are mentioned by Oppenheim. In one, large irregular exostoses of the upper cervical vertebrae to be felt in the neck caused paralysis and sensory disturbances in all four extremities associated with other signs of cervical myelitis. A long and energetic mercurial treatment is reported to have resulted in recovery. In another case a large round exostosis was situated in the tenth or eleventh dorsal vertebra, and caused marked signs of compression of the spinal cord. This case also is reported to have recovered under antisyphilitic treatment.

It is said that syphilis may produce softening and destruction of the vertebrae, similar to the caries of tuberculosis ; and that Pott's disease may result, and this can occur at any level, but it is most often met with in the cervical region.

Syphilitic disease of the vertebrae, however, is so rare that we must not be hasty in concluding that a case of Pott's disease in a syphilized person is necessarily syphilitic. Calmette's ophthalmic reaction, or a history or signs of tuberculosis elsewhere, should make one hesitate in diagnosing syphilitic disease, even though apparently the patient had benefited by antisyphilitic treatment. Again, care must be taken to exclude malignant disease. The signs of affection of the spinal cord and roots are the same as those met with in pachymeningitis, which will shortly be considered.

Jasinski, who, according to Williamson, has given special attention to the subject of syphilitic disease of the vertebrae, states that in 8 cases of syphilitic caries with treatment, 5 completely recovered, 2 improved markedly, and in 1 the result was not known.

THE PATHOLOGICAL ANATOMY OF SYPHILIS OF THE SPINAL CORD

Introduction. The syphilitic virus may set up a gummatous infiltration, diffuse or circumscribed, in the membranes, and produce symptoms by compression of the roots or spinal cord. It may be limited to the dura mater, but it is much more likely to spread to the subjacent arachnoid surface of the dura, thence to the pia-arachnoid, causing an adhesive inflammation to the substance of the cord, and it is then termed *meningo-myelitis.* Again, we have seen that a diffuse meningitis affecting the pia arachnoid may be associated with a diffuse basic meningitis. The appearances and changes are essentially the same in cerebral and in spinal meningitis ; the differences are only due to anatomical differences in structure and function. Just as we know that there may be various grades of severity of the skin eruption,—in one case consisting of only a few papules, in another covering gradually or rapidly the whole surface of the body,—so the affection of the membranes may be localised to a few patches, or it may disseminate rapidly or gradually over the whole of the spinal or the cerebro-spinal axis.

The symptoms likewise may be localised or general; they depend essentially upon the effects of (*a*) the meningitis, causing irritative and destructive changes in the roots, localised or generalized; (*b*) the extension of the inflammation along the pial septa into the substance of the cord, with subsequent cicatricial formation leading to destructive changes in conducting paths to and from the brain; and (*c*) the changes in the vessels, arteries, veins, and lymphatics, causing ischaemia and softening of the nervous structures, local or generalized, by obliterative endarteritis, endophlebitis, congestive stasis, and thrombosis.

The clinical forms which we have mentioned depend upon the degree and intensity of one or other of these processes operating singly or in combination with another or both. As we have pointed out in cerebral syphilis the polymorphism of the disease is a characteristic feature, so it is with spinal syphilis; and at one time the symptoms may point to meningitis, and at a later period to myelitis. It is of very great importance to note this fact and to remember that the pathological changes in the meninges are more marked than the gravity of the symptoms would indicate; in fact, grave and important symptoms may only come on when a local or generalized myelitis has occurred. Since myelitis is due to softening and destruction of nervous elements, often of great importance to the well-being of the individual, and treatment at this late period cannot restore these destroyed nervous structures, although energetic administration of mercury will often have such a beneficial influence as to lead one to *suppose* that this may have occurred, pathology, however, teaches us that destructive softenings are not repaired; the neural structures are replaced by neuroglia tissue, and such repair as does occur is really the result of arrest of the progress of the action of the syphilitic virus on the yet undamaged structures, whereby a substitution of function by uninjured structures occurs. Moreover, it is of importance to remember that, in association with every organic lesion of the nervous system, there is always a halo of functional disturbance due to the acute inflammatory change, and this halo disappears in favourable cases, provided the vascular conditions will allow of it. It cannot be too strongly emphasized that the serious organic changes occurring in the spinal cord are, as in the brain, due essentially to the vascular disease, especially when a spreading thrombosis, due to arteritis, takes place.

The lesions will be considered now under separate headings: *Syphilitic pachymeningitis.* The dura mater may be attacked consecutively to a vertebral caries; it may also be the primary seat of a diffuse or circumscribed gummatous infiltration, and the lesion may be limited to the dura mater, but it is much more likely that it will extend to the arachnoid surface, thence to the pia arachnoid, causing a symphysis to the cord. This may be localised to one part of the cord, causing a localised meningo-myelitis, or it may be diffuse, causing a generalized meningo-myelitis, as in a case recorded by Homen, in which there was a pachymeningitis and leptomeningitis, and all the membranes were united to form a fibrous sheath around the cord. Not infrequently the affection of the dura mater may take the form of a gummatous tumour, or it may lead to an affection in one region of the cord, e.g. the cervical is frequently the seat of the disease, causing hypertrophic meningitis.

Gummata of the membranes. Gummatous tumours situated in the dura mater, and compressing but not infiltrating the spinal roots and spinal cord are, comparatively speaking, very rare; only a few such case have been described. Moxon and Lepetit have each described a case of multiple gummata seated in the dura mater at the level of the cauda equina; in Moxon's case there was, besides, similar tumours in the spinal cord.

Zambaco and also Westphal have described cases in which there was a gummatous infiltration, which had invaded the dura mater over a wide area, and in filling up the spinal canal had led to compression of the roots.

It is much more common for the whole of the membranes to be involved, and probably the process starts usually in the soft membranes and spreads to the dura on the one side and to the spinal cord and roots on the other, causing a *meningo-medullary* *adhesion* (vide photomicrograph, Fig. 16, p. 134). Microscopically examined it will be found that there is a considerable hyperplasia of the fibrous tissue of the dura mater, with an infiltration of all the membranes and pial septa with lymphocytes and plasma cells. This *pachymeningitis* may be *focal* and take the form of a ring around the cord, or it may occur in widespread patches (e.g. Case 25, p. 131); it tends to affect the posterior surface and extends a greater distance behind than in front.

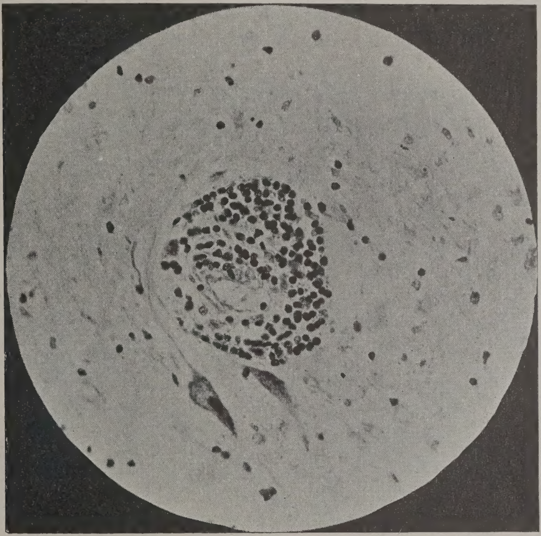

FIG. 13. Perivascular infiltration with lymphocytes and plasma cells from a case of gummatous cerebro-spinal meningitis.

Spinal gummata. The spinal gumma is very rare. Fagge states: 'A gumma beginning in the interior of the spinal cord is, I believe, an affection as yet unknown to pathologists.' Cases have since been described by Williamson and Gowers, the tumour being situated in the posterior horn; by Eisenlohr in the posterior column; and by Osler in the antero-lateral column and in different cord roots. The gumma is practically always associated with other lesions, macroscopic or microscopic, e.g. diffuse meningitis, pachymeningitis and vascularitis (vide Figs. 13, 14, 15 and Case 25, p. 131).

The medullary or meningo-medullary gumma may be solitary or multiple; it is variable in size; it usually starts in the membranes, or in the roots, but it may arise in the substance of the cord. The naked-eye and microscopic characters are the same as those of gumma in the brain; it may cause secondary degeneration in systems of fibres in the spinal cord, and when seated in the lateral column it has given rise to the characteristic Brown-Sequard phenomenon (vide Case 26, p. 130).

Observations upon a number of fatal cases of cerebro-spinal syphilis and of cases in which the symptoms of basal meningitis were predominant, show that in cases where the lesions are apparently circumscribed, it is common to find a number of lesions scattered over the whole extent of the central nervous system in various stages of evolution and devolution. Sometimes there only exists *to the naked eye* a single isolated focus of disease, but a closer and more attentive examination, aided by the microscope, will disclose signs (sometimes very evident) of a generalized inflammation, actual or passed. In fact it is right to affirm that syphilis of the nervous system is essentially a diffuse lesion, generalized through the whole of the neural axis and its enveloping membranes, the limited foci are only localised exaggerations of a pre-existing diffuse process. This is shown by the fact that there is a general peri-vascularitis in severe cases (vide Fig. 13).

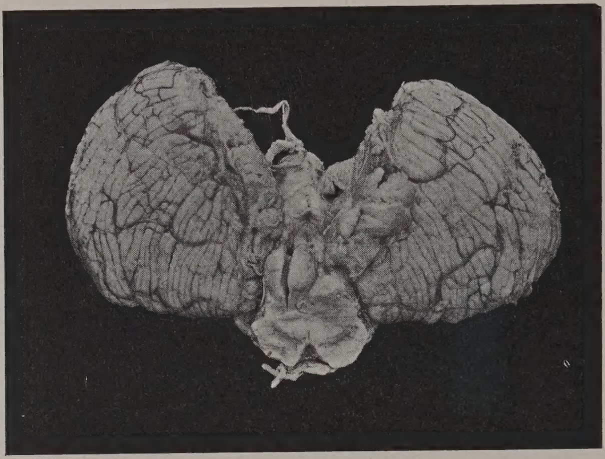

Fig. 14. Photograph of the under surface of the cerebellum, pons and medulla, with the crura cerebri cut through. A gummatous tumour is seen to involve the right corpora quadrigemina. It was about the size of a small Barcelona nut.

The following case of gummata of the spinal cord with microscopic examination shows that the gummatous tumours in the spinal cord were only a part and the less important part of a widespread syphilitic affection of the cerebro-spinal axis.

Case 25. A female, aged 44, was an inmate of Horton Asylum for eighteen days. The notes state that she was the subject of insanity with gross brain lesion. She had grandiose delusions, impairment of memory, the speech was typical of a general paretic. There was right-sided facial paralysis and spastic condition of the right arm and leg with Babinski's sign. The pupils were unequal, right larger than left, both reacted sluggishly to light and she had considerable difficulty in swallowing; the following is an abstract of the principal points noted at the autopsy and the microscopic examination of the tissues:—there was a general nodular endarteritis of the cerebro-spinal vessels, the leptomeninges at the base of the brain and spinal cord showed white or greyish-yellow thickened patches or streaks over the base of the brain and spinal cord; these patches consisted either of fibrous tissue, or of the same infiltrated with lymphocytes and plasma

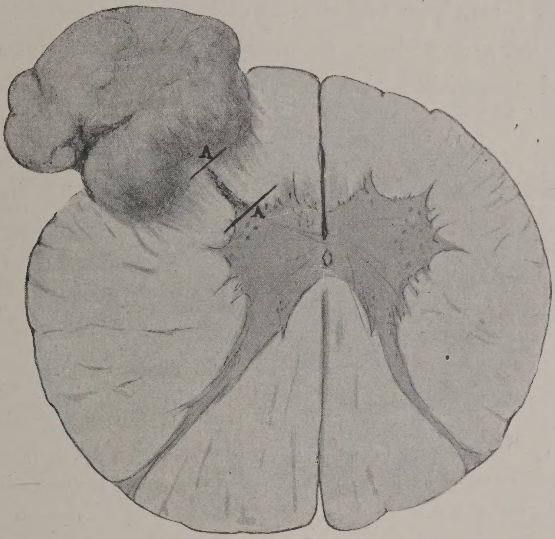

Fig. 15. Section of the spinal cord in the upper cervical region, showing a gummatous tumour, involving the left antero-lateral column and anterior root zone. The vessel A–A is shown more highly magnified in Figs. 15 A and 15 B. Stained by the Van Gieson method.

cells. The fourth ventricle was granular and dilated; there was a small tumour the size of a large pea, yellow in colour and of firm consistence, situated on the right superior cerebellar peduncle (vide Fig. 14). On the spinal cord were several small hard white nodules—the largest being situated in the right postero-lateral region of the seventh cervical segment; it measured 7 millimetres in diameter. Another rather smaller, situated in the right antero-lateral portion of the first dorsal segment (vide Fig. 15). There were also in the dorsal region a few similar nodules in the dura mater; all these nodules on microscopic examination were found to be gummatous tumours. Moreover, there was an irregular degeneration and sclerosis of the right antero-lateral column of the cord below the level of the first dorsal. A considerable portion of this degenerative sclerosis was due to an old softening discovered in the internal capsule of the left hemisphere; there was a marked degeneration of the Betz cells of the cerebral cortex; the vessels of the base of the brain as a general rule showed very old sclerotic fibrosis, but some of the smaller lenticulostriate arteries exhibited a more recent endarteritis. In some places in the cord the meningitis was of old standing, as shown by a dense fibrosis and thickened pial septa and vessels.

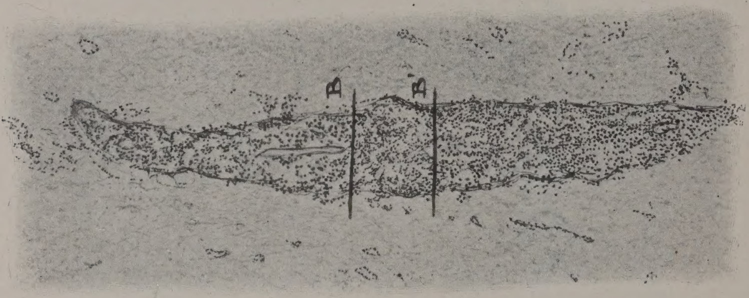

Fig. 15 A. The small portion A to A from the previous figure under higher magnification showing a small vessel with marked perivascular infiltration with lymphocytes and plasma cells. Magnification, 80 diameters.

In other regions, for example, near the gumma shown in Figs. 15 A and 15 B, the vessels exhibit a marked infiltration of their sheaths with lymphocytes and plasma cells; the conclusion I came to after the examination of the tissues was that the patient had suffered for years with undiagnosed syphilis of the central nervous system; for in some structures the effects of long past syphilitic inflammation were exhibited; in others, e.g. the gummata of the spinal cord and adjacent spinal substance showed a recent development. The case was not one of general paralysis, but of chronic syphilis of the whole central nervous system, and is of interest in showing how generalized the lesions may be, and how easily these may be overlooked by the inexperienced, for the brain and cord were sent to me on account of the tumour found on the cerebellar peduncle. Neither the vascular lesions nor the patches of meningitis, nor the tumours on the cord, nor the diseased condition of the vessels, had attracted attention; the case was thought to be one of typical general paralysis.

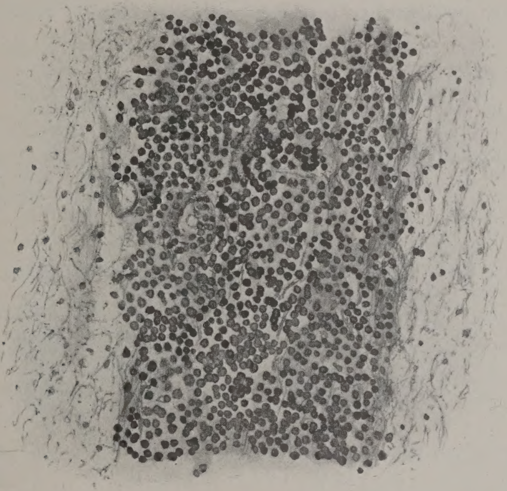

FIG. 15 B. The part B to B the same under a still higher magnification. Magnification, 250 diameters.

Syphilitic leptomeningitis. The pia-arachnoid may be affected primarily and alone without extending to the inner surface of the dura mater, or it may extend in patches or streaks to the dura mater, or, as we have seen, the whole of the membranes may be adherent. The naked-eye appearances of syphilitic leptomeningitis vary according to the age of the process; if quite recent, the appearances will be exactly the same as those described in the chapter on cerebro-spinal meningitis. It is rarely that one has the opportunity of seeing a case of syphilitic spinal meningitis, because it is seldom fatal in the early stages, unless the patient should die from some intercurrent malady, e.g. acute bed-sore, pneumonia, or septic nephritis secondary to cystitis.

Morbid anatomy. As a rule, when the spinal cord has been removed and the dura mater slit open, it will be seen that the pia-arachnoid no longer presents its normal delicate transparency; it appears thickened and has a greyish-yellow or greyish-pink colour. It may be generally opalescent, or the thickening and opalescence may occur in strands or patches. If the disease is of old standing, long and short strands or variable-sized patches of nacreous appearance may be observed (Fig. 16). This thickening of the membranes is especially likely to be found over the posterior surface, and usually it is more marked in the dorsal than the cervical and lumbar regions. Examined microscopically the appearances are the same as those met with in basic meningitis; there is the same infiltration of the pia-arachnoid membranes and walls of the vessels with lymphocytes and plasma cells, but in this form of the disease an opportunity of studying the condition of the walls of the veins is afforded; and it will be observed that the infiltration of the walls of the veins with lymphocytes is never absent. All the veins are not equally affected, indeed many remain intact, and side by side two vessels can often be seen in

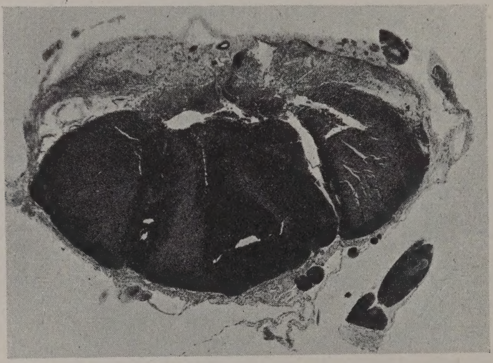

Fig. 16. Gummatous pachymeningitis affecting the anterior surface of the cord in the mid-dorsal region.

transverse section, the one with infiltration of its coats and the other normal. This applies also to the arteries ; and the phenomenon of a healthy-walled vessel lying by the side of an inflamed one bathed by the same cerebro-spinal fluid can only be explained by the supposition that the virus has gained access to the lymphatics of the one and not of the other. Again, the cell infiltration may occupy the whole wall, or be only seen on one side, forming thus a perivascular nodule. Several of these nodules coalescing and uniting with the general infiltration of the membranes may form a small gummatous tumour.

The wall of the vein is often split into a series of lamellae, between which are seen the embryonic cells ; the endothelium usually remains intact, but occasionally an obliterative form of meningeal phlebitis occurs. These lesions of the veins were first described by Greiff, and his observations have been since confirmed by numerous observers, including Schmaus, Möller, Siemerling, Lamy and Sottas. As reference to the affection of the veins has not previously been alluded to in the chapter on cerebral syphilis, it may be well to state that the veins in the skull are similarly affected in syphilitic meningitis, and to such an extent sometimes as to cause necrosis of the wall of the vessel and lead to subarachnoid haemorrhages.

Changes in the arteries are also found in the form of periarteritis and endarteritis already described. Plate XIV illustrates the changes in the arteries and veins in a case of cerebro-spinal leptomeningitis, fatal within a month of onset.

The accumulation and infiltration of lymphocytes and plasma cells in the lymphatic crevices and channels of the soft membranes and walls of the vessels is associated with a proliferation of the connective tissue-fibres of these structures, and when the embryonic cells disappear by absorption of the products of their granulo-aqueous degeneration, the fibrous connective tissue which has undergone a hyperplasia is left behind ; and this causes the naked-eye appearances of scar tissue in place of the delicate vascular membrane. But we have seen that the inflammatory process often extends along the pial septa into the substance of the white matter of the cord in the form of comma-shaped extensions, and the whole circumference of the cord may be thus involved, or only portions thereof, especially the postero-lateral regions.

Consequently not only is there in a transverse section of the cord of a case of leptomeningitis, which has proved fatal from some intercurrent disease many months or years after the onset of symptoms, a rind of cicatricial tissue, but extending into the substance of the cord are thick strands of similar tissue containing thick-walled vessels replacing the delicate pial septa (vide Figs. 1 and 2, Plate XV). Moreover, the walls of many of the vessels in the membranes and the septa have a uniform hyaline fibrous appearance. In the arteries a fibrous thickened endarterium can be seen, and the elastic coat is of several layers; finally, a dense fibrous tissue, which is continuous and indistinguishable from the thickened adventitia, occupies the place of the muscular coat. All the vessels, however, are never equally affected by this change; but neither are they equally affected in acute arteritis. The meningitis sometimes continues for many years and retains to the end an inflammatory character (vide Case 25, p. 131). It may be remarked that, although the general appearances described above accord only with syphilis, yet there is nothing absolutely specific about them; a tubercular meningitis may show all these characters, and unless the tubercle bacilli were demonstrated, a mere examination of the spinal cord, apart from clinical symptoms, would not suffice to differentiate one from another. The Wassermann reaction would, however, if present, settle this point. Unless there is secondary microbial infection there is a striking absence of polymorphonuclear leucocytes in the cell infiltration; moreover there is no fibrinous exudation on the surface such as occurs in purulent meningitis. It is of importance to remember the constancy of the lymphocyte infiltration, for it serves to explain the fact that a measure of the activity of the disease and the effect of treatment can be estimated by the relative number of lymphocytes contained in a definite quantity of cerebro-spinal fluid withdrawn by lumbar puncture and centrifuged (vide Case 35, p. 167).

Although the meningitis may be generalized more or less, yet occasionally fatal cases occur in which there is a focal lesion with or without symphysis to the dura mater, causing a focal meningomyelitis with systemic degeneration in ascending and descending tracts. Examination of the roots, especially the posterior, shows an infiltration with cells, and in late cases a fibrous hyperplasia. We may, as in sleeping sickness, regard this condition as a lymphangitis produced by the entrance of the virus along the lymphatics of the vessels and to a less degree of the nerves. In the case recorded on p. 113 the lymphatics and spaces of the posterior spinal ganglia were filled with lymphocytes and plasma cells. As a rule the degeneration of the neural elements is slight as compared with the chronic inflammatory changes ; and when systems of fibres undergo degeneration, it is because there is thrombotic occlusion of the arteries or veins producing a focal myelitis. This transverse lesion produces an interruption of the long tracts in the white substance and causes a secondary degeneration, and ultimately a sclerosis of ascending tracts (vide Figs. 1, 2, 3, 4, 5, 6, Plates XV, XVI). But there may be a general vascular disease of the spinal cord, and as a result of thrombosis or occlusion of vessels patches of softening with haemorrhage may occur in the grey as well as the white matter. We may thus have the picture of acute myelitis, and it would not be right to assert that it was of syphilitic origin, unless there were a history or signs of syphilitic affection and a condition of vessels such as has been described as occurring in syphilitic meningitis. Syphilis is a predisposing cause to myelitis, and it may be assumed that other factors, such as microbial invasion or microbial toxaemia and cold, would be more likely to lead to a spreading myelitis if there were vessels the walls of which had been in any way damaged by syphilis. When the grey matter is affected an acute polio-myelitis with atrophic muscular paralysis may occur. A young man was admitted to my wards recently in whom a polio-myelitis developed with wasting of the small muscles of the hands, the forearms, and shoulders. No cause could be ascertained except that he had acquired syphilis six months previously. He left the hospital rather than allow lumbar puncture to be performed.

A rapidly-spreading ascending myelitis may occur very occasionally which may simulate Landry's paralysis. The macroscopic and microscopic appearances of acute syphilitic myelitis in no way differ from those of other forms of myelitis. Hyperaemic congested vessels, some of which may have ruptured and caused haemorrhages into the grey matter, are seen associated with a leucocytic infiltration; the ganglion cells are seen in all stages of destruction, they will have lost their proper shape; the processes are broken off; there is an absence of Nissl granules; there is a uniform dull staining of the cells from coagulation necrosis, the nucleus being hardly visible; many of the cells may be actually crumbling and disintegrating, or are being devoured by phagocytes. Amidst the degenerating cell elements are degenerating varicose fibres, granulation corpuscles, and droplets of myelin in various stages of chemical reduction. The white matter also shows dilated congested vessels and scattered haemorrhages, as if there were a vasomotor paralysis. This gives rise to a characteristic naked-eye appearance termed punctate myelitis (vide p. 157, and Plate XVIII).

It is obvious from the above-mentioned facts and from the consideration that no two individuals are exactly alike as regards their powers of resistance to disease, nor in the morphological conditions relating to the vascular supply of the spinal cord, that the symptomatology, depending as it does upon the nature, the intensity, and the extent of the pathological process, must present a polymorphic, kaleidoscopic character. It must be remarked, however, that this in itself is in accordance with what the pathological processes teach us as regards all syphilitic affections of the nervous system.

Spastic spinal paralysis; discussion as to its pathogenesis. The lesions hitherto described have *primarily* affected the nutrient, enclosing, and supporting structures of the spinal cord, causing a *secondary* degeneration of the neural structures by inflammatory processes, by compression, and by ischaemia. But can the syphilitic virus, apart from these conditions, occasion a primary neuronic decay, insidious in origin and progressive in character and limited to the lower extremities? According to Erb it can, and does do so in some instances; and he affirms that there is analogous to the primary spastic paralysis (tabes dorsale spasmodique of Charcot) a primary syphilitic spinal paralysis. The Berlin school, notably Oppenheim and Siemerling, have contested this interpretation of the symptom-complex which Erb associates with a primary degeneration process of the pyramidal system of fibres controlling the lower extremities.

Before proceeding to discuss the subject in fuller detail it is desirable to consider certain anatomical facts why the symptoms of spinal syphilis should be limited to the lower extremities and affect especially the bladder and bowel; in fact why all the symptoms in the great majority of cases should be associated with nervous structures below the level of the mid-dorsal region. I have pointed out on p. 336 that in tabes the roots which are earliest and most constantly affected are the third or fourth to the seventh or eighth dorsal, and the fifth lumbar to the second or third sacral (vide p. 337). Sicard, speaking on tabes at the International Medical Congress, 1906, said: I explain the reason that tabes so frequently commences in the dorsal region by the disposition of the pia-arachnoid *cul de sacs* of the posterior roots at this level; they are more numerous and deeper, consequently a toxin in the cerebro-spinal fluid would cause a radicular neuritis more readily in this region. As I have suggested in my article Tabes in Hospital and Asylum Practice (*Archives of Neurology*, vol. ii), there may be another reason for a *locus minoris resistentiae* in the mid-dorsal cord and lowest lumbar and sacral regions. If the arguments are valid a reason can be found for the frequency with which spinal syphilis causes affection of the spinal cord in the mid-dorsal region as compared with the cervical and lumbo-sacral regions. That the mid-dorsal region should be the site of predilection for a meningo-myelitis may be due to the fact that this portion of the spinal cord is dependent upon a more or less variable and precarious blood-supply. Moreover, that the posterior portion of the cord should suffer more often and more readily than the anterior in syphilis may also be due to the fact that the posterior spinal arteries are smaller and more variable than the anterior. If we consider briefly the arterial supply of the cord we shall see that the above argument is founded on fact. The two anterior spinal arteries join and form a median artery in the anterior fissure; the posterior spinal arteries join, but do not form a definite arterial trunk down the cord like the anterior, but form a plexus of small vessels which enter into the formation of the arterial circle formed by union of the anterior and posterior branches. Refreshing arteries of varying size and situation enter into the supply of the cord in the dorsal region by anterior and posterior roots. A large branch, which is constant, comes in *on the anterior roots* of one of the lowest dorsal or upper lumbar segments, enters the median fissure, and divides, one branch going up, the other down. This region of the cord, then, is comparatively well supplied, and the precarious supply will be in the region between its upper branch and the descending median artery formed by the junction of the anterior spinal arteries, viz. the mid-dorsal; consequently an endarteritis of the spinal vessels would produce ischaemia more easily in this region of the cord. But the veins follow the course of the arteries, and the lymphatics are for the most part contained in the adventitia of the blood-vessels or perivascular sheaths; consequently this is the region in which venous congestion and lymph stasis are most likely to occur both in the membranes and in the substance of the cord. All these conditions together may explain why there should be a tendency for meningo-myelitis to occur with especial frequency in the mid-dorsal region; also why this should be the seat of predilection for a *syphilitic transverse focal myelitis.* Moreover, the cord is smaller in this region, and the inflammatory process would have a shorter distance to extend from the periphery in order to produce a complete lesion. Again, in the lower dorsal region the pyramidal tract comes to the surface in the posterior angle of the lateral column, and an adjacent meningitis would spread directly into it. The tendency to a *peri-arterial inflammation* and *congestive stasis in the veins and lymphatics* would, in the case of general spinal vascularitis, make this region the *locus minoris resistentiae* in the acute stage. Moreover, when the acute meningitis has passed off and a slow sclerosing fibrosis occurs, it would be in this region that such a sclerosing formation would be most intense and most likely to result in a chronic fibrous infiltration along the pial septa enclosing the nutrient vessels of the cord substance (vide

Figs. 1 and 2, Plate XV, and legend). If it be admitted that these arguments are valid they would serve as an explanation of Erb's cases of syphilitic spinal paralysis and do away with the necessity of assuming that there is a primary degenerative process affecting the pyramidal system below the dorsal region.

General remarks upon the symptoms of spinal syphilis. The symptoms which may be presented by spinal syphilis must of necessity vary according to the extent and intensity of the chronic inflammatory process. The lesion may be localised or generalized throughout the spinal canal, or there may be scattered foci of the disease. The symptoms of the disease will depend upon the roots and segments of the cord that are involved and damaged by the gummatous infiltration, and particularly by its spreading along the septa to the substance of the cord, involving thereby the long conducting tracts of fibres to and from the brain ; in such case a focal meningo-myelitis leads to the symptoms of a transverse focal myelitis. Although the symptoms vary in different individual cases, yet certain signs and symptoms and the peculiarities of their onset and progress are fairly constant and of characteristic significance and diagnostic importance.

Meningitis. The inflammation of the membranes is manifested by a feeling of stiffness in the neck and the back ; by Kernig's sign ; by pains in the neck, the back, and the sacrum, not infrequently severe and obstinate, but sometimes only of moderate severity and unaccompanied by hyperaesthesia ; numbness, tingling, pins and needles, or severe *pains radiating* into the upper and lower limbs or in various parts of the trunk may occur, associated with areas of paraesthesia or hyperaesthesia, in which pains and a diffuse painful sensibility on pressure may occur. Among the most common and significant sensory troubles is the *girdle pain* ; according to Charcot these pains are worse at night ; however, in many cases the pains may be so slight as to be overlooked. Besides these subjective symptoms—indications of sensory root-irritation —there may be symptoms and signs of motor root-irritation in the form of spasm and cramps of muscles. In many cases there is stiffness of the spine combined with some *general tenderness on* *percussion of the spine*, as well as pain on assuming the erect posture. The superficial and deep reflexes are at first increased. If the roots are seriously involved by gummatous infiltration (vide Plate XIV), actual destruction of fibres may occur and *patches of anaesthesia* and *analgesia.* Such a group of symptoms, pointing indubitably to meningitis, is usually *unaccompanied by fever.*

Severe paralysis with muscular atrophy and change of electrical excitability indicate a severe affection of the motor roots with destructive atrophy. I have seen one such case; but the following case with autopsy, recorded in the Clinical Society's transactions, 1895, by the late Dr. Beevor, is instructive as showing the effect of gummatous infiltration :—

CASE 26. P. S., formerly a soldier in India, now a gardener, who said he had had gonorrhoea, but not syphilis. Following a wetting he began to drag the left leg, and within a few hours the left arm became weak ; he took to his bed and wasting of the arm muscles came on. A week after onset, pain in the left shoulder, elbow, and wrist, and numbness of the left thumb and radial border of the wrist and forearm occurred. Pupils unequal, right larger than the left, but both reacted to light and accommodation. Sensory dissociation, loss of painful sensation to heat and cold, with retention of tactile sensibility over the right half of the body as high as the nipple. Later, the analgesia and thermo-anaesthesia spread to the ulnar border of the right arm. The wasted muscles of the arms did not give the reaction of degeneration, but required a stronger faradic current than normal. He died about two months after admission, or four months after the onset of symptoms. Internal strabismus, delirium, drowsy stupor, and subnormal temperature preceded death a few days.

At the autopsy several gummatous tumours were found on slitting the dura mater, gummata were also found in the brain, also an endarteritis obliterans. 'On the wall of the basilar artery was a typical gumma.' In the liver there were several gummata. Dr. Beevor says : 'It seems probable that the symptoms were caused by the tumour on the left side of the brachial enlargement and adjacent parts (third cervical to second dorsal roots) pressing on the cord, thus producing the paralysis and wasting of the left arm; but whether the analgesia of the right side was caused by the left-sided tumour, and why there should have been such profound loss to pain and temperature, and none to tactile impressions, it is difficult to say.' Dr. Beevor remarks upon the infiltration of nerve-roots *and the cord.* It is unfortunate that no satisfactory microscopic examination of the cord was made.

Compression and irritation, or loss of function of the roots and structures in the circumference of the spinal cord may occur, but the tendency of the symptoms is to clear up in one place and spread in another. Under the influence of mercurial treatment the symptoms rapidly disappear in many instances. There are, in addition to those mentioned already, certain symptoms which are characteristic of meningitis, viz. regional hyperaesthesia and anaesthesia, vasomotor paralyses, and irritative phenomena; in nearly all cases there is more or less trouble with the bladder; in addition there is some paresis of the limbs or of a single extremity; not infrequently the patient does not move a limb on account of the fear of movement exciting painful paroxysms, and it may be thought that the limb is paralysed. Although, doubtless, cases of pure syphilitic spinal meningitis do occur, the opportunity of verifying this post mortem seldom if ever occurs, for the disease, all the while it remains limited to the *membranes of the spinal cord* and has not extended to the cord itself or affected the vessels so seriously as to cause occlusion, is not fatal and yields readily to mercurial treatment. As already mentioned, syphilitic meningitis is an early, often a very early symptom. Probably lumbar puncture would show that slight meningitis is a more frequent condition than is generally supposed. Oppenheim lays stress upon the variability of the condition of the knee-jerks, one day they may be brisk and after a few days disappear again to reappear. This may be explained by the fact that the intensity of the inflammatory process tends to subside in one situation while extending to another. Thus the roots which are connected with the reflex arc may on one occasion not be affected, and a little later they are seriously involved or vice versa. The tendency of meningitis is, however, to extend to the spinal cord and produce the commonest form of spinal syphilis. Cases in which the pains are very severe and paroxysmal, and in which there is stiffness and rigidity, are more favourable, for they indicate that the roots are irritated, but that the disease has not made enough intramedullary extension to interfere with the transmission of sensation to the brain, and usually such cases yield to treatment.

Meningo-myelitis. The previous remarks which have been made respecting syphilis of the spinal cord show how important a part the distribution of the vessels play in the symptomatology, and that the disease affects both arteries, veins, capillaries, and lymphatics. The gummatous processes affecting the dura and soft membranes may, as we have seen, cause a transverse lesion and ischaemic softening of the cord, producing ascending and descending degeneration of the long tracts. The symptoms, therefore, may be a combination of those of meningitis with those of transverse myelitis.

The meningitic symptoms often precede by days, weeks, and months the symptoms of a focal myelitis, and, fortunately, may be so severe as to cause sufficient alarm of the patient to make him consult a doctor; in other cases they may be so trifling, that the patient puts down to *muscular rheumatism* the stiffness in the back and the radiating pains in the limbs, until a *girdle sensation*, with paraesthesia and paresis in one or both legs, leads the patient to consult a doctor; or perhaps no advice is sought until the motor weakness has increased to a paraplegia. The paresis or paralysis is mostly of a spastic character. The disturbances of sensibility may be those of meningitic affection of roots already described, combined with those due to an imperfect transverse lesion. In general the sensory disturbances are subjectively less pronounced than the motor. They may consist of paraesthesia and hyperaesthesia, affecting various root areas of the limbs and trunk, or there may be numbness and tingling in the limbs with painful areas on pressure.

It is curious how only sensibility to heat and cold or pain or touch may be affected in some particular region; there is, in fact, a sensory dissociation. The temperature sense may be affected whilst the light tactile, pressure sensations and the prick of a pin may be felt and correctly localised, or the converse may be the case.

The deep reflexes are increased at an early stage, the superficial reflexes may be present, either diminished or increased. One of the earliest, most important, and most persistent of symptoms is some bladder trouble, and for this the patient often consults a doctor, and the other signs and symptoms are discovered upon examination. André-Thomas has called attention to the premonitory period of syphilitic paraplegia. He asserts that one of the principal signs is intermittent spasm of vessels of the spinal cord. The symptoms are diffuse, motile, and transitory ; they appear and disappear suddenly. Bizarre sensations, giving way of the legs, spinal pain, and bladder troubles are among the transitory complications. If we recognize this premonitory period and institute early antisyphilitic treatment the patient is saved from an irremediable infirmity.

The most frequent seat of *meningo-myelitis* is the *dorsal region* for reasons already stated. When the *cervical region* is affected, a paresis of all four limbs may occur, associated with radiating pains and perhaps atrophy of the muscles of the arms. When the lowest cervical and first dorsal segments are affected we may have affection of the sympathetic, contraction of the pupil, enophthalmos, and perhaps one half of the face shows anidrosis or dysidrosis, anomalous secretory activity of the sweat glands. *Cervical meningo-myelitis* is pretty sure to be associated with some evidence of pre-existing basal meningitis (vide p. 113). If the *lumbo-sacral region* is the seat of the meningo-myelitis there is a likelihood of a flaccid paralysis of the legs, and superficial as well as deep reflexes will be abolished ; moreover, the sensory disturbances will be severe in the lower extremities. But the most serious symptoms relate to the bowel, the bladder, and the genital organs. There may be incontinence of faeces, and incontinence of urine, although the bladder is never empty. The detrusor and sphincter may both be paralysed, and water dribbles away continuously from a paralysed distended bladder. Such a condition, sooner or later, ends in cystitis, which is very difficult to treat and is liable to be followed by septic nephritis. Again, partly owing to the difficulty of keeping the patient clean and the skin aseptic and partly to the vasomotor and trophic disturbances, sacral bedsores are very liable to arise. Impotence in the male may arise as a result of the roots and spinal centre connected with the genital act being involved in the morbid process.

Other varieties of meningo-myelitis, e.g. spinal hemiparaplegia with crossed hemianaesthesia, Brown-Sequard phenomenon, may occur. Armstrong has reported a case of crural monoplegia, accompanied by anaesthesia of the opposite limb arising two years after the chancre. It was cured by treatment. Brown-Sequard's paralysis rarely occurs except in syphilis of the spinal cord. It is rare for syphilis to cause paralysis of all four limbs. Cases have, however, been recorded by Weidner and Buttersack. Usually a transitory weakness of the upper limbs, accompanied by a certain amount of rigidity, is all that is found. Certain muscular atrophies of a progressive type, recalling subacute or chronic progressive anterior polio-myelitis, have been described as complications of syphilis. I have observed several rapid cases of amyotrophic lateral sclerosis in the subjects of syphilis, and I have thought there is no reason why a primary progressive decay of the efferent motor system should not occur as the result of syphilis.

Gummatous meningitis of the roots of the cauda equina. A gummatous meningitis may affect the structures in the lower end of the spinal canal, causing a complex group of symptoms due to irritation and loss of function of the roots of the cauda on one or both sides; not infrequently the symptomatology points to a unilateral affection. I have met with two cases in my hospital practice, but in neither of these was the lesion demonstrated post mortem. I will therefore refer to a fatal case, recently published by MM. Laignel-Lavastine et Verlin, in which the course of this affection is described, and in which the symptoms presented by a female patient during life can be correlated with the anatomical changes found post mortem.

The symptoms were as follows:—right-sided sciatica, weakness of the leg, stepping gait, abolition of the patellar, tendo Achillis, anal and plantar reflexes, retention of urine, constipation, tactile, painful and thermal anaesthesia of the foot and leg extending up the inner surface to within 4 centimetres below the knee, upon the external surface up to the knee, and posteriorly there was a long anaesthetic flap extending to the fold of the buttock. In the perineum, the anaesthetic region comprised the right half of the surface, including the mucous and cutaneous surfaces of the labium majus, the vestibule with an encroachment of the left half, the internal surface of the vagina, and behind the perianal region, which was a little less anaesthetic at the periphery than the centre. Moreover, there also existed a slight left hemiplegia, due to softening, the result of syphilitic arteritis. Lumbar puncture gave only blood, which in itself favoured the diagnosis of inflammation and adhesions of the roots.

The autopsy confirmed the diagnosis in showing a meningo-radicular matting of the right half of the cauda equina, involving six sensory roots on the right side, viz. lumbar v, sacral i–v, with a corresponding unilateral necrosis and a degeneration of the posterior columns of the spinal cord. Reference to Fig. 11, p. 112, will show that the anaesthesia observed during life corresponds with the roots affected.

Again, an interesting and valuable communication has recently been made by Spiller pointing out the course of an affection of the conus medullaris in cerebro-spinal syphilis. He describes a case of cerebro-spinal syphilis which presented the following symptoms. There existed a bilateral peroneal paralysis which affected first the left side, then the right, whilst the anterior tibial muscles remained intact; there was paresis of the flexors of the legs and of the extensors of the feet; objective disturbances of sensibility in the skin areas supplied by the first and second sacral roots; loss of the tendo Achillis reflexes, loss of the plantar reflexes, with preservation of the knee-jerks and integrity of the functions of the bladder and of the rectum. He points out that bilateral peroneal paralysis resembles very much polyneuritic paralysis of the lower extremities. The author relates two other observations of lesions of the conus medullaris of traumatic origin in support of his conclusions regarding his own case.

Cases of Spinal Syphilis

Case 27. C. H., aged 22, gunner in the navy, came to me in Sept., 1907. He contracted syphilis in Hong Kong in 1902, where he was treated in the hospital for three months with mercurial injections. In May last, about five years after infection, he noticed weakness in his legs, difficulty in starting micturition, although the desire was very urgent, and sometimes it dribbled away. As a rule he is constipated, but occasionally there is slight incontinence of faeces. He has had no headache, no vomiting at any time since infection, nor stiffness in the muscles. There has been no girdle pain and no pain or swelling of the legs. The extremities have felt cold and somewhat numb, otherwise no paraesthesia. He is a moderate drinker and smoker.

Physical condition. There are pigmented scars on the legs, the pupils are regular, equal, and react to light and accommodation; he walks with a spastic gait and complains that the outer sides of the soles of his boots wear out in consequence of his walk; he has a difficulty in clearing the ground with his toes; there is some muscular rigidity; there is no muscular wasting and no tenderness; there is paresis in both legs more marked on the left side; there are no tremors and no inco-ordination. There is a little blunting of sensibility to pain and touch in the toes of both feet; elsewhere no disturbance of sensation discovered.

Reflexes. Abdominal and cremasteric reflexes are absent. Plantar *extensor* reflex present (Babinski's sign) on both sides. Knee-jerks exaggerated and ankle clonus present.

The patient thinks his walking powers have improved with antisyphilitic treatment.

This case is a localised meningo-myelitis affecting the lower dorsal region of the spinal cord.

Case 28. W. Y., aged 26, ex-policeman, was admitted to Charing Cross Hospital, Sept., 1891, for loss of power in his right leg, which came on more than a year previously, causing him to give up his occupation. At the age of 20 he contracted a soft chancre, but no secondary symptoms followed, nor can any definite syphilitic residua be found.

There is no wasting of muscles, and there never has been, and they all respond to the faradic current.

All the deep reflexes are exaggerated on both sides, but more especially on the right ; not only is there ankle clonus, but there is clonus of the hamstring muscles and calf muscles when the skin over them is touched with a feather or the hair pulled with forceps.

He complains of *shooting pains,* occasional and not severe, in the right ilio-hypogastric region. There is constipation and difficulty in retaining his water.

Lying on his back he can raise the legs and flex the toes on the right side. Lying on his face he can occasionally and with great difficulty flex the hamstrings on the right side ; usually, however, he can only perform this movement in conjunction with the left hamstrings. He walks with the aid of a stick and with difficulty like a hemiplegic.

Sensory disturbances were found over the right lower extremity as high as the iliac crest, and corresponding, therefore, to the whole of the *posterior roots* below the twelfth dorsal. There was no zone of hyperaesthesia, but the following sensory disturbances were found :—

1. Greatly diminished sensibility to pain tested with pin and pulling a hair with forceps.
2. Light tactile sensation almost abolished.
3. Pressure with large surface recognized but diminished and somewhat confused ; with small, it is not usually recognized.
4. Cold not well recognized, but better than heat ; sometimes one is confused with the other.
5. There is observed not infrequently an allo-aesthesia.

A somewhat similar case was recorded by Dr. Buzzard in his valuable Clinical Lectures ; he remarks that the sensory disturbance being on the same side as the paralysis points to the sensory troubles being of root origin. The explanation I would offer of these somewhat unusual symptoms is this, that the meningitis has involved especially the roots from the first lumbar downwards on the right side, the paralysis is a unilateral spastic paralysis, and not due to involvement of the spinal motor neurones and roots, but to the sclerosis of the crossed pyramidal tract which in this region lies at the periphery of the lateral column close to the entry of the posterior roots into the posterior horn.

Doubtless the posterior column was affected, and if it had been possible to have seen a transverse section of the spinal cord above the lesion there would have been discovered a unilateral degeneration of the fibres that enter into the formation of Goll's column. The bladder and bowel trouble is doubtless due to the involvement of the posterior roots combined with a degeneration of the pyramidal systems of both sides.

The patient improved rapidly under treatment with mercurial inunction, showing that some of the symptoms were due to exudative meningitis rather than the later sclerosing condition.

Erb's Spastic Spinal Paralysis

Erb, in 1892, described a group of cases occurring in the subjects of syphilis which he considers are distinct from focal meningo-myelitis in the dorsal region, and due to a primary degeneration in the ascending cerebellar and posterior median tracts and the crossed pyramidal tracts. The symptoms occur later, and there develops gradually a spastic paresis of the legs with marked increased deep reflexes ; although the gait is extremely spastic the muscular contraction is but slight. The bladder is early and almost constantly affected. Disturbances of sensibility are usually present, but only slightly manifest. The course is chronic in most cases, and there is a tendency to improvement, to remissions, and even to complete arrest. The disease may extend over many years and the danger to life is only by complications, intercurrent disease, and especially cystitis and septic infection, or other disease of syphilitic origin occurring.

When, in 1892, Erb published his description of the disease no post-mortem evidence thereon was forthcoming. He regarded the probable anatomical basis of the disease as a symmetrical degeneration in the posterolateral columns. Numerous neurologists, including Oppenheim and Marie, asserted that these cases were really due to a syphilitic meningo-myelitis. Since that time nine or ten cases of typical syphilitic spinal paralysis with post-mortem examinations have been published. These cases are those of Westphal, Eberle, Max Nonne (two cases), Williamson, Long and Wiki, Dreschfeld, Wimmer, and Renner ; in addition, an interesting case of acute syphilitic disease of the spinal cord has been published by Joseph Collins, in which he calls attention to the main features of these cases and contrasts the anatomical changes observed in his own case ; at the same time pointing out that the examination of an example of the disease in its incipiency shows that some cases, at least of this disease, syphilitic spinal paralysis, are dependent upon syphilitic myelitis.

Max Nonne has devoted much attention to this subject, and in his admirable book will be found a detailed description of all the cases which have been published and a critical analysis thereon ; his conclusions are that, although syphilitic spinal paralysis is clinically a well-defined entity, it has by no means a constant unvarying morbid anatomy.

It is certain that the anatomical basis of this disease is either a primary combined system-tract-degeneration in the posterior and lateral columns without specific syphilitic disease of the spinal cord, or it is due to a diffuse myelitic process in which also the spinal vessels are involved in a true syphilitic inflammation also the membranes to a greater or lesser extent.

The larger number of cases belong to the latter category.

Joseph Collins thus sums up the main facts of the anatomical substratum of this complex group of lesions, based upon Erb's work and analyses of cases.

(1) A chronic, punctate transverse myelitis with ascending and descending degeneration ; (2) a similar condition associated with primary degeneration of the pyramidal tracts ; (3) degeneration of the pyramidal tracts alone ; or (4) degeneration of the posterior and of the lateral columns (pyramidal tracts, direct cerebellar tracts, and Gowers' tract), a combined system-disease.

The recently published case of Max Nonne substantiates his contention that a focal myelitis may be followed by symptoms corresponding to Erb's paralysis.

Long and Wiki's case showed ' a punctate myelitis in the dorsal region, a degeneration of the lateral pyramidal tracts, direct cerebellar tracts and Goll's column and acute arteritis. The authors consider the tract degeneration to be secondary to the punctate myelitis, but Erb, in commenting upon the case, maintained that the main factor was a combined system disease with chronic sclerosis of the blood-vessels, by the side of which the rather diffuse chronic myelitic lesions in the dorsal cord appear etiologically as a quite permissible complication.'

Wimmer of Copenhagen, in 1907, published two important cases. The first case was only observed clinically; it is of interest because of the short time, three years, which elapsed between the primary infection and the onset of symptoms of Erb's syphilitic spinal paralysis, viz. paresis of the lower extremities; increase of tendon reflexes, no muscular contractures, slight bladder disturbance, and sensory disturbances of considerable degree.

The second case, which was observed both clinically and anatomically, had begun eighteen months after infection, and exhibited, according to Nonne, the symptoms of Erb's paralysis, although not in quite its pure form. The patient, six months later, developed cystitis, and flaccid paralysis of the lower extremities, dying subsequently of septicaemia from pyelo-nephritis. The anatomical research showed (1) a focal myelitis in the eighth and ninth dorsal segments, (2) slight leptomeningitic changes in the dorsal and cervical cord, (3) extensive vascular changes, (4) degeneration of Goll's column, the dorsal and ventral cerebellar tracts, and the direct and crossed pyramidal tracts.

Finally, there is the important question, Are the symptoms characteristic enough to point with the greatest probability to a syphilitic process in the spinal cord? Erb takes this view, Leyden and Goldscheider oppose it. On the other hand, Koch has sifted 41 cases of non-specific myelitis and could not find the group of symptoms described by Erb once, and Wimmer arrives at the same conclusion from his experience; my experience, so far as it goes (I have seen about half a dozen cases, all of them syphilitic), supports Erb's contention.

The two following cases are of interest:

Case 29. J. T., barge worker, married, one child, 12 years old. At the age of 30 contracted syphilis; about *six weeks* after the appearance of the sore he suffered with a *severe headache*; the pain was stabbing and came on in paroxysms; he was treated at the London Hospital with pills and iodoform application, but after one month he neglected further treatment, because he thought the pills were the cause of his headache. About one year later he began to have difficulty in passing his water, and *gradually* a stiffness and weakness in his legs set in. He never had any girdle sensation. At the age of 35, that is about four years later, he was admitted to Cane Hill Asylum on account of mental depression and delusions of persecution, probably the result of alcohol. When I saw him he was able to give quite a rational account of himself, and I made the following notes of his history and physical condition. There are enlarged cervical glands, no skin eruptions or scars; but there is a well-marked scar on the glans penis. He has a markedly spastic gait, and can only walk with crutches. The knee-jerks are exaggerated, there is ankle clonus and Babinski's sign on both sides, and wrist-tap contraction on the left side. He has difficulty in passing water and his motions. There is a little blunting of sensibility to pain and touch in both feet and ankles.

There are certain points of interest in this case, viz. the severe headache occurring so early after the sore indicating a probable infection of the membranes, and the onset of serious spinal meningo-myelitis within a year of infection, probably in consequence of his neglect to continue the treatment. This case seems to show a latent period after the first infection of the membranes, which occurred at about the same time when the roseolar rash would usually appear.

Case 30. W. D. C., worker in lead, aged 34, was admitted to Colney Hatch Asylum, June, 1897. He states that he has never had colic, although there is a blue line on the gums. He gave the following history. Contracted syphilis at 19 and attended the Lock Hospital for some time. Seven years later he gradually became paralysed in both legs, especially the right, for which he attended St. George's and the Welbeck Street Hospital. He had difficulty with his water.

Present state :—His speech is somewhat impaired, there is a little hesitancy and slowness; there is tremor in the upper lip, but his conversational powers are pretty good; the tongue is protruded in the middle line and there is no tremor. Pupils are *equal and react to light* and accommodation; there is a marked spastic gait; the knee-jerks are very exaggerated and there is ankle clonus on both sides. Wrist-tap contractions both sides, and he has a fairly good grasp in both hands; there is a scar of an old gumma on the leg. He says that the colours have got into him and 'there is a lot of arsenic in bronze and white lead'. He has had epileptiform fits. The fits went on and he became more enfeebled mentally. A year later he was still having fits and kept repeating the colours have got into him. His memory and comprehension are more defective. Aug. 10, 1898. He does not know the year; kept repeating in answer to questions, the colours have got into him. He recently had had a fit with right-sided unilateral convulsions and conjugate deviation of the head and eyes to the right. The speech is hesitant, but not syllabic or tremulous. *The pupils are equal and react to light and accommodation.* The physical condition above described persisted, and no improvement but gradual deterioration occurred, and he died in the following March.

The brain showed naked-eye characters of chronic meningo-encephalitis. A full report of the microscopic examination of the brain of this case is given in vol. i, *Archives of Neurology*, p. 141. It was shown that the meningo-encephalitis did not accord with that of general paralysis; it was probably a lead encephalitis. The spinal cord exhibited a chronic localised meningo-myelitis, about the level of the sixth and seventh segments (vide Figs. 1, 2, 3, 4, 5, 6, Plates XV and XVI), with degeneration of the long ascending tracts above, and degeneration of the long descending tracts below this level. This was a case of syphilitic spastic paraplegia, the result of a meningo-myelitis, in which years later a meningo-encephalitis developed.

Microscopic examination of the sections under a higher magnification shows a marked thickening of the leptomeninges in the mid-dorsal region, and an annular sclerosis of the subjacent spinal cord consisting entirely of neuroglia substance; besides this there is a sclerosing degeneration of the long ascending and

PLATE XV.

Sections of the spinal cord of a case of meningo-myelitis with symptoms of Erb's spastic spinal paraplegia. The sections were stained by Weigert's method. The yellow portions of the white matter indicate a sclerosis, the sclerosis being most marked in the mid-dorsal region. The roots show comparatively little degeneration. At the sixth dorsal there is almost a complete annular sclerosis. The sclerosis is most marked in the lateral columns. At the level of the third to fourth dorsal there is also an annular sclerosis involving especially the posterior part of the lateral column. In the cervical region there is a marked sclerosis of Goll's column, and the direct cerebellar tracts, and a light diffuse sclerosis of the remainder of the circumference of the antero-lateral columns.

To face p. 154.]

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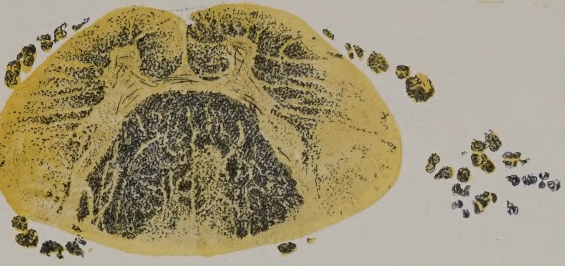
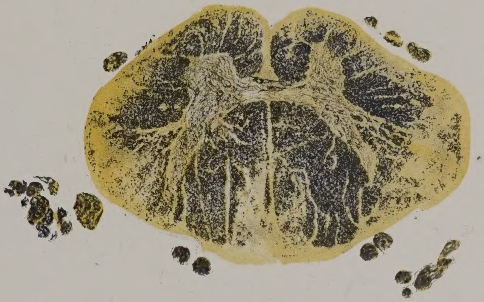
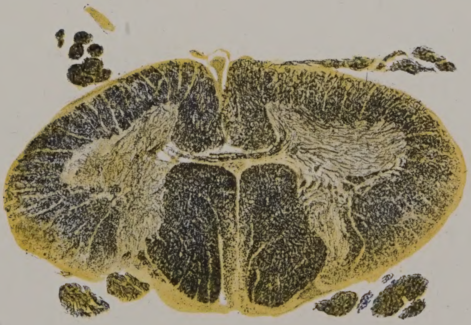
PLATE XV.



I. 6th Dorsal.



II. 3rd Dorsal.



III. 7th Cervical.

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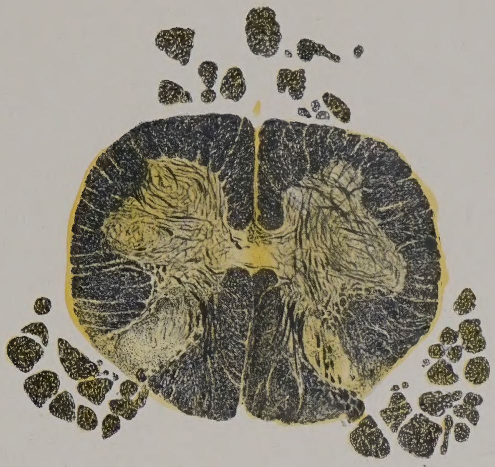
Plate XVI.

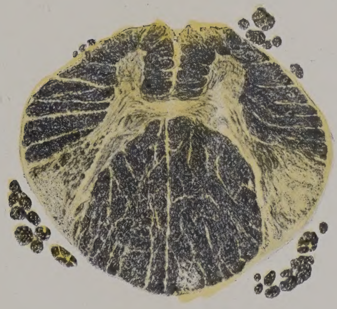
Further sections from the same case. From the eighth dorsal downwards the degeneration is almost entirely limited to the posterior part of the lateral column, and consists mainly of the region corresponding to the crossed pyramidal systems of fibres. In the lumbo-sacral region the sclerosis becomes more diffuse and less readily perceived with the naked eye. It is quite obvious when seen with a low-power lens.

To face p. 154.]

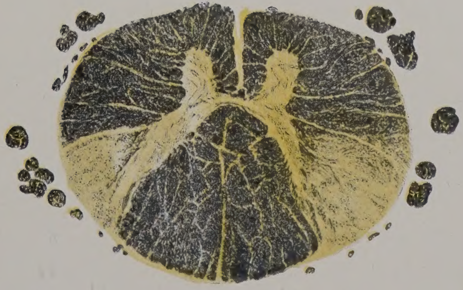
PLATE XVI.



VI. 5th Lumbar.



V. 10th Dorsal.



IV. 8th Dorsal.

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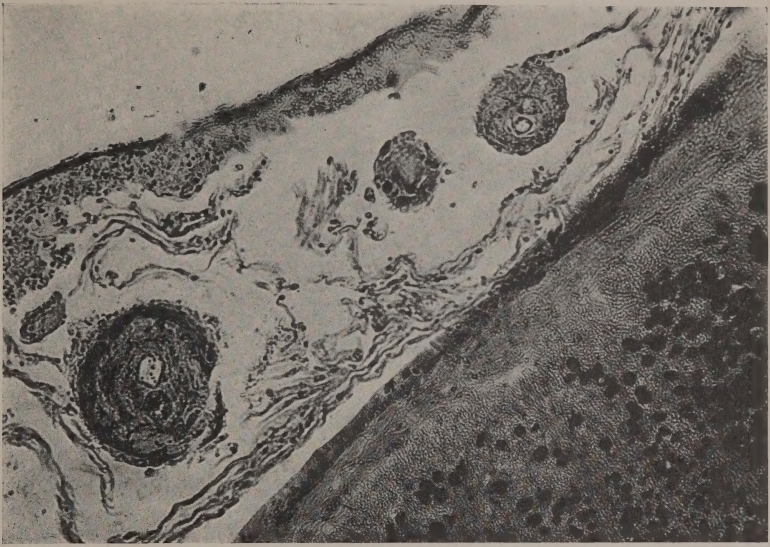
PLATE XVII.

1. Photomicrograph of the posterior surface of the sixth dorsal, showing the annular sclerosis of the cord, and the thickened membranes in which are seen three vessels in transverse section. The lumen of one is completely obliterated, and there is hardly any lumen in the other two. Magnification 120 diameters.

2. Shows the larger vessel under a magnification of 440 diameters. Two small vessels are seen side by side in the centre of a fibrotic substance, filling up the whole of the original lumen of the vessel. This is due to an old syphilitic obliterative endarteritis with thrombosis. The thrombus has become organized and vascularized in the middle.

To face p. 154.]



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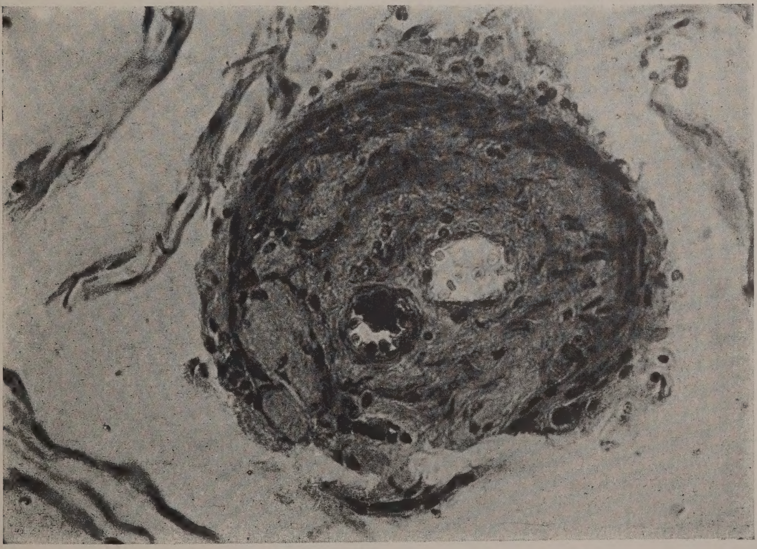

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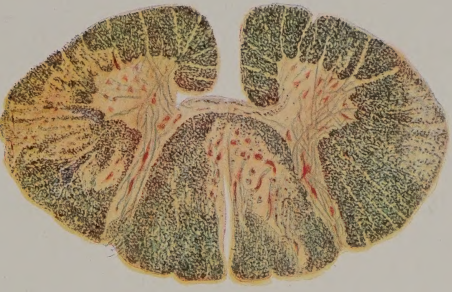
Plate XVIII.

Sections of the spinal cord in (1) the upper cervical, (2) mid dorsal, and (3) lower lumbar regions, from a fatal case of myelitis, occurring in a man eighteen months after infection, in whom a large sacral bed-sore developed, causing septicaemia and death within a month of the onset of the myelitis. He was treated with mercurial inunction. The sections of the spinal cord are stained by Weigert's method, and show the changes described fully in the text.

To face p. 154.]

PLATE XVIII.



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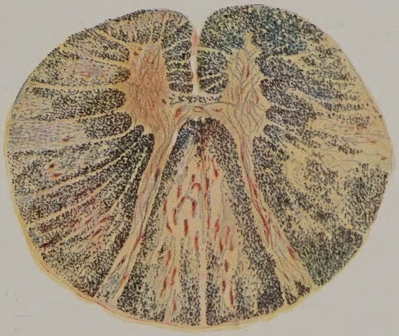

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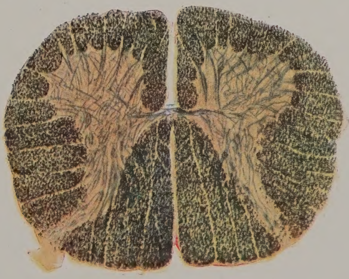

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descending tracts. There is very little evidence of root degeneration, but some of the posterior roots show a sclerotic atrophy of fibres. The grey matter shows no noteworthy changes; the anterior horn cells in this and other regions as well as the cells of Clarke's column, appear to be fairly normal in appearance. There are no haemorrhages, and beyond a little arterio-capillary fibrosis and filling up of the central canal I could discover no evidence of an antecedent central myelitis. The degeneration of the ascending tracts, viz. Gowers' tract, direct cerebellar tract, and the column of Goll above the lesion I should associate with the meningitis and its annular spread into those tracts in the mid-dorsal region; this would likewise account for the pyramidal tract degeneration below the lesion. The clinical symptoms accord with this interpretation of the anatomical facts.

Careful comparative examination of the vessels of the meninges, roots, and cord at different levels, show that there is a general, though by no means universal angio-sclerosis, which may be associated with the hyaline fibrosis described by Gull and Sutton, but in the mid-dorsal region I found appearances in transverse sections of vessels which I was unable to find elsewhere, viz. evidence of a past obliterative endarteritis and possibly thrombosis of vessels in the much thickened meninges (vide photomicrographs, Plate XVII).

Many of the small stiffened vessels, smallest arterioles, and capillaries have ruptured and given rise to recent *microscopic* haemorrhages in the meninges.

ACUTE TRANSVERSE SYPHILITIC MYELITIS

Acute myelitis may occur in a person the subject of syphilis and be merely a coincidence; or some predisposing cause such as cold, wet, and trauma may lead to a vascular stasis in vessels already suffering with the effects of the syphilitic poison, but not enough to cause symptoms. The disease is more likely to be wholly due to the action of the syphilitic virus, in my opinion and according to my experience, the sooner it occurs after the primary infection. Leyden, in 1874, reported cases presenting the clinical picture of acute myelitis; since then numerous contributions have been made in which the anatomical basis of the affection has been described.

Some statistics show that it is a relatively frequent form of disease of the spinal cord in syphilis, thus Orlowsky found 19 cases out of 72; Max Nonne saw it much less frequently, viz. three times in 92 private cases, and five times in 120 hospital cases.

Mode of onset. It may come on quite acutely, the lower limbs being completely paralysed in a few hours, or the development of a complete paraplegia may only happen after a few days. The paralysis is almost always total and absolute, so that from the pelvis down to the sole of the foot there is complete loss of movement. The segmental level of the spinal lesion determines the extent of the motor paralysis of the trunk; it must be extremely rare for the upper extremities to be affected, for only one case has been reported.

In the majority of cases there is a profound sensory affection, although individual cases may exhibit various forms of disturbance of sensory function; in some cases there is a complete loss of sensibility to all forms of stimulus, or there may be a retention to a more or less extent of certain sensations, while others are lost; the appreciation of thermal sense is especially likely to be retained when the others are abolished; but it may happen that light tactile sensation is retained, although there may be analgesia and thermo-anaesthesia; even thermo-analgesia may alone constitute the sensory disturbance.

The Brown-Sequard phenomenon may occasionally occur. The tendon reflexes are lost when the myelitis affects the lumbar spinal cord; if, however, it affects only the dorsal cord the tendon reflexes may be present and even exaggerated.

The sphincters of the bladder and rectum are early and severely affected, and oedema, due to a vaso-motor paralysis is especially liable to occur in the paralysed lower extremities; moreover, large rapidly-spreading bedsores over the sacrum occur early and often lead to septicaemia and a rapidly fatal termination.

Williamson has reported a case in which the paralysis came on in a man apparently in good health and while at his work; in most cases, however, premonitory symptoms occur. One of my cases, an attendant at an asylum, was seized almost suddenly with weakness in the legs while in execution of his duties; he rapidly lost complete power in the lower extremities and there was marked sensory disturbances, with loss of control of sphincter and bladder; in a few days a sacral bedsore appeared, which rapidly spread to a huge size. There was a history of infection eighteen months previously. I took him into Charing Cross Hospital under my care, administered mercury by inunction, and treated the bed sore; he made a perfect recovery, and after three months was able to resume his duties as an attendant and clarionet player. Another case which I had the opportunity of observing many years ago, was that of an Italian waiter, who, eighteen months after infection, developed an acute myelitis with motor and sensory paralysis of the lower extremities; here also a huge bedsore and paralysis of sphincters occurred; he died eight weeks later from septicaemia. In this case I found a diffuse myelitis in the dorsal region. A perivascular lymphocyte infiltration was found in the mid-dorsal region, but no endarteritis; all the ascending tracts were degenerated in the cervical region and below the crossed pyramidal tract (vide Plate XVIII and Fig. 17).

Prodromal symptoms. (1) Sensory paraesthesia, and radiating shooting and stabbing pains may be felt in the lower extremities, in the hips, and in various parts of the trunk and spine. Besides there is often a certain stiffness of the back and spinal irritation, a symptom which both Charcot and Oppenheim have laid stress upon as frequent and comparatively characteristic. Motor irritation is manifested by spasmodic contractions and cramps in the lower limbs, the feet, and the toes, alternating with a feeling of weakness and followed by paretic conditions. The bladder and rectal symptoms are manifested first by retention and constipation, but later there is incontinence.

The patellar reflex may vary between excessive, normal, and diminished activity. These prodromal symptoms may last days, weeks, or even occasionally months. The temporary character of the prodromal symptoms, appearing suddenly or comparatively suddenly, and after a varying period of time has elapsed, disappearing again to reappear, and sooner or later ending in a definite spinal paralysis, is especially suggestive of syphilitic myelitis. In such a case the application of the Wassermann test in the early prodromal stage would be most useful for diagnostic purposes.

Course. In the fully established form of the disease a marked improvement may occur for days or weeks, even without any special therapeutic treatment, but this improvement may not continue, and even the symptoms may all return. In some cases the disease may run a very rapid course, terminating fatally in a short time. Thus Williamson has described a case fatal on the sixteenth day. Schmaus, a case which died on the fourteenth day. The following summary of a case described by Joseph Collins is a fairly typical illustration of the course of the disease and the complications likely to arise and cause death.

Case 31. A youth, aged 23, addicted to alcoholism, was infected with syphilis, Sept., 1907. Cutaneous and mucous membrane manifestations developed promptly. December, 1907, he suffered with aphonia, due to syphilitic laryngitis. Six months after infection he developed weakness, stiffness, and paraesthesia of the lower extremities and slight difficulty in urinating. The weakness of the legs developed in intensity and he became completely paraplegic. This was followed by retention of urine, and later by incontinence of urine and faeces and impotency. After a short time under treatment he recovered sufficiently to leave the hospital, but cystitis and pyelo-nephritis set in and he died eight months after infection.

‘When he left the hospital he was able to walk without assistance, the gait being one of enfeeblement and spasticity. The power of flexion and extension of the legs and thighs was very little impaired. All the tendon jerks of the lower extremities were increased, the Babinski phenomenon and ankle clonus were present. The abdominal and cremasteric reflexes were not elicitable.’ Examination of the sensory state of the lower extremities showed postural sensibility, normal tactile sensibility very slightly dulled in the feet, and thermal sensibility more impaired than any other form. On the legs he did not readily distinguish warm from hot objects, and unless the object was very hot he did not distinguish heat from touch.

'*Summary of pathological changes.* Areas of softening, principally in the posterior half of the cord on transverse section extending from the first to the ninth dorsal segments associated with changes in the blood-vessels, thickening and round-celled infiltration of the vessel walls, circumvascular exudation, vascular thrombosis and haemorrhages, syphilitic myelitis, sclerotic patches in part due to glia cells, principally towards the periphery of the cord, especially of the posterior and postero-lateral tracts, secondary degeneration of the posterior columns, especially of the column of Goll, and also of the direct cerebellar tract and Gowers' tract in the upper thoracic and cervical regions; slight but distinct exudative meningitis, patchlike distributions in many thoracic segments. The cells of Clarke's column much degenerated; those of the anterior horn suffering to a much less extent, possibly the effects of sepsis.'

The following acute case reported by Klippel and Dainville is also of interest, not only on account of its rapid progress, but from the fact that spirochaetes were searched for, but not found.

CASE 32. A woman, three weeks after her marriage, developed a chancre, followed later by characteristic secondary symptoms. There were three pregnancies, the two first born dead, and macerated; the husband admitted syphilis and married within two years after the appearance of the primary sore; he was only treated for two months. She received no treatment up to the time she was admitted to the hospital, aged 23; it was therefore a case of acquired non-treated syphilis. On admission to the hospital she suffered with lightning pains, abolition of reflexes, paralysis of the lower limbs predominating on one side, sphincter and trophic troubles, and in spite of antisyphilitic treatment a large sacral bedsore developed and she died within twelve months of the onset of symptoms.

The anatomical lesions found post mortem showed an intense exudative meningitis surrounding and compressing the roots, and a degeneration in the posterior columns more marked on one side and causing an ascending degeneration of the columns of Goll.

There was an intense perivascularitis, both of the roots and of the intramedullary structures. In spite of the most careful search at the Pasteur Institute no spirochaetes could be found. This, the authors say, may be attributed to the secondary microbial invasion resulting from the sacral bed sore, and they state that sections showed bacteria passing by the roots to the spinal cord. The negative results of search for the spirochaete, according to the authors' opinion, in no way invalidate the etiological and anatomical proofs of the syphilitic origin of the disease.

NAKED-EYE AND MICROSCOPIC CHANGES IN ACUTE SYPHILITIC MYELITIS

Sections of the spinal cord, stained by Weigert's method, of the acute case referred to on p. 157, exhibit a patchy sclerosis (vide Plate XVIII), and if these sections be examined microscopically the following meningeal and vascular changes will be found : the lymph sheaths of the vessels, arteries, and veins in the meninges and in the substance of the cord will be found swollen, distended, and filled with young embryonic cells (vide Fig. 17); the vessels, generally speaking, are gorged with blood corpuscles, as if there had been inflammatory stasis ; in many places the small vessels have ruptured and given rise to small extravasations of blood corpuscles. The degenerated areas and the grey matter under a low power present a punctate appearance on account of these congested vessels and the haemorrhages. The degenerated areas show a proliferation of neuroglia cells and fibres ; the more recent the degeneration the more evident are the appearances of breaking up and degeneration of the myelin sheath, because the absorption of the fatty degeneration products takes time for its completion. A spreading ascending myelitis such as this case exhibits does not differ markedly from other cases of acute non-syphilitic myelitis, and we do not know how far the absorption of a poison, due to the septic bedsore, by the lymphatics of the roots and the vessels entering the spinal canal may not have contributed, if they have not altogether produced, the inflammatory changes found post mortem.

Microscopic examination of the sections under a higher magnification shows that the irregular patches of degeneration in the white matter above and below the focal myelitis in the mid-dorsal region correspond in great measure not to a system tract degeneration, but to an area of vascular distribution ; for in the midst of the patches of sclerosis are observed sections of congested vessels giving it a punctate appearance, while in the surrounding undegenerated white substance no such vessels are seen. Consequently the two facts may be correlated, and it is a justifiable conclusion to arrive at that the patches of sclerosis have been the result of acute degenerative atrophy of the fibres caused by an inflammatory stasis and thrombosis of vessels in those areas (vide Fig. 17).

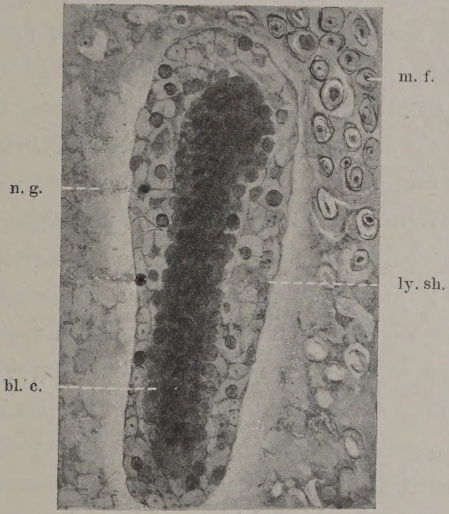

FIG. 17. A small vessel showing its lumen dilated and filled with blood corpuscles (*bl. c.*). The sheath of adventitia is greatly thickened owing to an inflammatory proliferative hyperplasia of the lymph sheath (*ly. sh.*). There are a few transverse sections of medullated fibres (*m. f.*) seen in the surrounding cord substance, but the majority have been destroyed, leaving only the interstitial neuroglia (*n. g.*). Magnification 400 diameters.

If these congested and thrombosed vessels are examined under a high power, the following appearances will be observed. They are mostly small vessels greatly dilated and filled with red blood corpuscles ; in some the outline of the corpuscles is clearly visible, in others not ; the vessel wall is greatly thickened, but a careful examination shows that this is due to a proliferative hyperplasia of the cells of the lymphatic sheath of the adventitia, as if some toxin had entered the perivascular lymphatics. No doubt this lymphangitis produces vascular stasis in the region of the cord where it has been shown the vascular circulation is most precarious, viz. the mid-dorsal region, and it spreads sometimes upwards, sometimes downwards, and sometimes in both directions. If the source of the poison were due to the sacral bed sore or the cystitis one would rather have expected the lumbo-sacral cord to have been affected in this case, but it will be seen from Fig. 3, Plate XVIII, that this is not the case. Moreover there is no evidence of a meningitis affecting the roots, consequently this acute myelitis, in the absence of any other cause, may be attributed to syphilis with some degree of probability.

Disease of the anterior grey cornua, poliomyelitis anterior. The anterior grey cornua may be affected in the course of a myelitis or meningo-myelitis; there will then be paralysis and wasting of groups of muscles corresponding to the segments of the spinal cord affected; moreover there will be electrical changes and reaction of degeneration. The changes which would be found in the spinal cord would correspond to those found in all forms of myelitis in which the anterior cornua are the seat of the inflammation.

Max Nonne states that he has seen three cases of poliomyelitis anterior occurring in the subjects of antecedent syphilis. One case was that of a woman, the other two were men. In all three cases only the upper extremities were affected; in two cases there were still manifest symptoms of syphilis present, and in all three an arrest of progress occurred in consequence of a specific treatment. The following case was recently under my care in Charing Cross Hospital, and is of a similar nature to the cases of Max Nonne. It is doubtful how far these cases can be regarded as *directly* dependent upon syphilis, but to my mind it must be something more than coincidence. There was an exposure to lead poisoning in this case, but no evidence thereof; there was no doubt about the syphilis, which, if it was not directly responsible for the poliomyelitis, certainly would act as an important contributory factor by producing a lowered resistance in a man predisposed to the affection of the anterior cornual grey matter.

CASE 33. J. B., aged 35; occupation, handyman and *painter* for last three years. Admitted March 5; discharged April 4, 1909.

Complaint. Loss of the use of his hands.

History. About a month ago he noticed his right hand getting stiff, and in cold weather, numb. These symptoms grew progressively worse and extended up into the arm, the left hand and arm becoming similarly affected, though to a lesser degree. At present he cannot move the right arm below the elbow, and the movements of the left are very stiff and limited. Has not had colic or constipation, and presents no blue line on the gums or any sign or symptom of lead poisoning. His legs have become weak since the attack, and he has lost weight considerably of late. He contracted syphilis six months ago, and has had two months' treatment.

Physical signs. Pupils react to light and accommodation, although sluggishly.

Right arm. Patient cannot move the thumb or fingers, nor extend or flex the wrist, or even flex the elbow. The triceps can still be controlled and used in extending the elbow. Supination and pronation of the wrist are lost. The deltoid muscle is very wasted, and except in its anterior fibres does not act. He cannot abduct the arm at the shoulder. The scapular muscles are also wasted, although the trapezius seems fairly normal. The serratus magnus is wasted and weak in its action. The pectoral muscles are normal. *Fibrillary twitching* may be noticed over the back.

Left arm. Fingers can be moved, also the thumb, but the latter cannot be opposed by the fingers. Wrist can be flexed but not extended. Pronation and supination very weak. Flexion at elbow very weak. Abduction of the arm at the shoulder is limited. The wasting of the muscles of the arm is very marked, but not so much as on the right side.

Reflexes. Knee-jerks, slightly exaggerated, but are equal on both sides. Babinski's sign is very doubtful. There are no sensory disturbances and no loss of control of the sphincters. Lumbar puncture was performed. No leucocytes were seen in the cerebro-spinal fluid. The blood showed 100 per cent. of haemoglobin. Red cells, 4,340,000 per cubic millimetre. A few red cells showed the granular degeneration of Grawitz.

The muscles which showed RD were :—

Right.	*Left.*
Deltoid	Deltoid
Supinators	Supinators
Biceps	Biceps
Flexors	All muscles of forearm and thenar and hypothenar eminences.
Add. pollicis	
Opp. pollicis	
Interossei	

The eyes showed no fundus changes. The patient went out because he refused to submit to a second lumbar puncture.

Amyotrophic lateral sclerosis. Ballet has called attention to a set of symptoms simulating amyotrophic lateral sclerosis and has published the following interesting case.

Case 34. A man, aged 34, mentally unbalanced, was suddenly attacked with right hemiplegia and dysarthria. Three weeks later a left hemiplegia occurred and the dysarthria became more marked. One month after the commencement of these two seizures the patient presented the following clinical picture : excessive emotivity, readily bursting into tears or laughter, paralysis of the tongue and soft palate, defective articulation of words, raucous voice, alarming attacks of suffocation, exaggeration of masseter reflex, in brief—labio-glosso-laryngeal palsy of the spasmodic type. The upper and lower limbs were almost completely paralysed, there was exaggeration of deep reflexes and clonus. There was a marked degree of atrophy of all four limbs ; the muscles of the tongue were not, however, atrophied. There were neither sensory nor sphincter troubles. The patient was syphilitic. The symptoms rapidly diminished under the influence of a mixed treatment of mercury and iodide. Ballet eliminates successively amyotrophic lateral sclerosis, especially by reason of the sudden onset, the rapidity of evolution and the retrocession of symptoms with treatment. He concludes from the suddenness of the onsets, the bilateral hemiplegia and the emotivity, that it was a case of pseudo-bulbar paralysis dependent upon a double cerebral lesion of syphilitic origin.

I have seen a case of rapid amyotrophic lateral sclerosis occurring in a comparatively young man, the subject of antecedent syphilis, with late tertiary symptoms. A man, while in the army, contracted syphilis at 20, for which he was only treated for one month. He was admitted to Charing Cross Hospital at the age of 36, suffering with amyotrophic lateral sclerosis. There was a history pointing to a gumma on the sternum occurring ten years after infection, which disappeared with treatment, and not long before his admission to Charing Cross Hospital a lump came on his head which also disappeared under treatment. So there can be but little doubt that he was at that time suffering with tertiary syphilis; not long after this second gumma had been cured he developed the signs and symptoms of amyotrophic lateral sclerosis, which ran a rapid course, terminating in complete labio-glosso-laryngeal paralysis and death. Antisyphilitic remedies had no influence upon the disease. He had no mental symptoms, and post-mortem examination with subsequent microscopic investigation showed that this was a system degeneration of the motor path of brain and cord not due to gross syphilitic affection of membranes or vessels. It might be urged that the parenchymatous degeneration of the motor path from cortex to periphery was either a coincidence in a person, the subject of syphilis, or that it was due to mercurial treatment. I have occasionally seen cases in asylums dying of general paralysis with marked degeneration of the pyramidal systems of fibres, sufficient to be the cause of ankle clonus and Babinski's sign, but these signs are extremely rare in general paralysis.

Pseudo-tabes syphilitica. Oppenheim and Eisenlohr simultaneously in 1888 observed cases of individuals the subjects of antecedent syphilis, who presented a series of symptoms simulating tabes dorsalis at least in one stage of the disease, which disappeared, or at any rate improved under antisyphilitic treatment; moreover, anatomical research in fatal cases has demonstrated the existence of a syphilitic meningitis involving the posterior roots with secondary degeneration of the posterior columns. Oppenheim has designated this affection pseudo-tabes. The main symptoms are absent knee-jerks, ataxy, lancinating pains, and bladder troubles. Besides, in these cases, analogous brain symptoms to those of tabes occur, viz. ocular paralysis, transitory or permanent, pupil rigidity more often than not both to light and accommodation, laryngeal paralysis, nerve deafness, anaesthesia in the distribution of the fifth, which may be due partly to basal meningitis and gummatous neuritis, and partly to simple atrophy of the cranial nerves and their roots. Cases have been described with anatomical examination by Oppenheim, Eisenlohr, Siemerling, Brasch, Von Ewald, Collins, Gajkiewiez, and Williamson (Max Nonne). Von Tiedmann and Nambu have reported an interesting case of cerebro-spinal syphilis of the pseudo-tabic variety. There was a widespread ataxy of the arms and legs, and attacks of vomiting like gastric crises, violent headache, and reflex pupil rigidity. At the autopsy a widespread generalized cerebro-spinal syphilitic meningitis was found. Wilbrand and Saenger state that in a case where there is a history of acquired syphilis, followed later by tabetic phenomena, the appearance of a central scotoma must not be considered a symptom of commencing optic atrophy, but as an expression of a syphilitic retrobulbar neuritis affecting the papillo-macular bundle. Eisenlohr calls attention to one of his cases of pseudo-tabes with central scotoma. He says that if the scotoma is non-progressive the case is probably not tabes. One of his cases supports this opinion. There was a transitory paralysis of the abducens which would correspond with a typical tabetic symptom. There was also a non-progressive amblyopia which did not progress to a marked amaurosis and optic atrophy, although there was some degree of atrophy evident upon ophthalmoscopic examination. Subsequently the patient died, and microscopic examination revealed a meningitic process which accounted for the affection of the optic nerve. It may therefore be concluded that every case of defective vision with tabetic symptoms is not parasyphilis, but may reasonably be due to active syphilis, and will therefore benefit by mercurial treatment. The following case which came under my observation was sent in under my care as a case of tabes dorsalis ; it was seen by several very competent practitioners who also diagnosed tabes. I have not the least doubt, as events turned out, it was a case of pseudo-tabetic cerebro-spinal syphilis.

Case 35. A woman, aged 34 years, was admitted to Charing Cross Hospital, said to be suffering from tabes. There were no signs of syphilis on the body. Her youngest child is aged 4 years ; fifteen months ago she had a seven-months stillborn infant. Four months ago she suffered with numbness in the legs, of which she took little notice ; then she had double vision and tingling in the feet and legs, which developed into lancinating pains shooting from the back down the legs. For the past fourteen days she has suffered from a girdle sensation. She came to the out-patient department and was admitted under my care. She had shooting pains in the legs, unsteadiness in gait and station, a feeling of the soles as if walking on cork, unequal pupils which reacted sluggishly to light and to accommodation, pain and cramp in the muscles of the legs, absent knee-jerks, patches of anaesthesia on the legs, and a belt of thoracic anaesthesia with girdle sensation. After inquiring into the history and finding that she had suffered with headache and squint, that the knee-jerks which were absent on admission had returned a few days later, I came to the conclusion that this woman, with a probable duration of infection of not more than four years, was suffering really from pseudo-tabes, the result of syphilitic meningitis, especially as she told me that she had had a little stiffness in the neck, and I then obtained Kernig's sign. Lumbar puncture was performed, and 390 lymphocytes per cubic millimetre were found—an enormous number for tabes dorsalis. This large number of lymphocytes could only be accounted for by a widespread active gummatous change in the meninges. She was placed on mercurial inunction. The symptoms began to clear up rapidly and a fortnight later the lymphocytes had fallen to seventy per cubic millimetre, and the fluid this time was tested by the Wassermann method, and found to give a negative reaction for both antigen and antibody. Unfortunately, the blood was not tested on this or future occasions. A fortnight later the cerebro-spinal fluid was examined and only twenty lymphocytes per cubic millimetre found, the patient being almost well. A fortnight still later, there were no lymphocytes, and the fluid was negative to the Wassermann reaction. The patient was quite well; the pains, anaesthesia, and unsteadiness had entirely disappeared.

This case shows the desirability of trying a mercurial cure in all cases of tabes in which there are atypical characters, where the Wassermann reaction is absent and the lymphocyte reaction marked. As clinical indications of pseudo-tabetic lesions may be mentioned the following symptoms: (1) sudden onset or comparatively sudden onset and rapid progress of symptoms; (2) early appearance of affection after primary infection; (3) a variability in the condition of the tendon reflexes, especially patellar and Achilles reflexes, at one time lost, at another present, even increased; and more marked on one side than the other; (4) the optic nerve lesion causing a unilateral central scotoma, the other eye unaffected; (5) the marked improvement under treatment, as was so strikingly shown in the above case.

It is probable that some of the cases of cured tabes are really cases of pseudo-tabes, also some of the cases which have been diagnosed as tabes occurring within a few years of the primary infection and which have run a rapid course.

AFFECTIONS OF THE PERIPHERAL NERVES

A secondary affection of the peripheral nerves may occur owing to syphilitic disease of the bones, lymphatic glands, fasciae, and muscles. The nerves may be irritated, causing pain and hyperaesthesia or paraesthesia or motor spasm, according as the function of the nerve is sensory or motor or sensori-motor; a nerve may be so damaged by compression or the extension of inflammation as to lose its conductile functions, and anaesthesia and paralysis result. A nerve compression from periostitis syphilitica is more often diagnosed clinically than anatomical facts warrant.

It is conceivable that syphilitic periostitis may so affect the intervertebral foramina as to cause symptoms pointing to affections of the nervous structures passing through; although

I have seen malignant sarcomatosis, especially secondary lymphosarcoma, causing symptoms of irritation and compression of the nervous structures in the intervertebral foramina, and this has been confirmed at the autopsy. I have not met with a case due to syphilis.

Not only may compression by syphilitic inflammatory deposits cause a local pressure atrophy, but even more important in the production of symptoms is the extension of the inflammation to the epi-, peri-, and endo-neural lymphatics, causing thereby a spreading neuritis.

Cases have been described clinically of a primary peripheral *peri-endoneuritis gummosa*, and these have been diagnosed on account of the fact that symptoms of neuritis have occurred in a patient the subject of syphilis; palpation has given evidence of nodular thickening in the painful nerves, and these signs and symptoms have disappeared under appropriate treatment (Ehrman).

The anatomical changes, however, have not been observed post-mortem, and it is only a reasonable supposition that the morbid condition which would be found would be a lymphocyte and plasma-cell infiltration accompanied by an endarteritis of the nutrient vessels and scattered perivascular nodules in various stages of necrobiotic and fibrotic change.

It is quite probable that a peripheral polyneuritis might be found in the cases of gummatous spinal-root neuritis (vide Case 24, p. 113, also cases by Buttersack and Kahler), in which the anterior and posterior roots have been found post mortem surrounded with a thick layer of neoplastic formation sufficient to cause irritative and paralytic motor and sensory root symptoms; but such an associated condition would be very difficult to determine during life unless pressure on the nerves caused pain and nodular thickening was discoverable by palpation. A differential diagnosis between the spinal root neuritis of syphilis and the clinically somewhat similar sarcomatous or other malignant growths of the vertebrae and spinal membranes would be greatly facilitated by a history of syphilis combined with a positive sero-diagnostic reaction.

Syphilitic neuritis may cause severe *neuralgia* and neuralgias of the fifth nerve are especially frequent in the early stages of the disease. Lang believes that some of these cases of neuralgia of the trigeminus may be occasioned by meningeal irritation (vide Case 4, p. 57). The neuralgia may affect one or all of the branches of the fifth.

Debove has recently reported cases of syphilitic affection of the peripheral nerves ; and he calls attention to the fact that syphilis by its parasitic nature may early in the disease give rise to general troubles and to nervous complications. He points out that lumbar punctures at this period prove the meninges to be affected, resulting in the inflammatory affection of certain cranial nerves at their origin and exit, leading to compression, resulting in paralysis and neuralgias according as the inflammation has affected motor or sensory nerves.

Hence we may have paralyses of the seventh and the third nerves and neuralgias in the distribution of the fifth nerve or its branches. He reports four cases : in the first there was paralysis of the seventh and neuralgia of the fifth ; in the second neuralgia of the fifth pair and paralysis of the seventh ; in the third a paralysis of the second ; in the fourth paralysis of the third pair, a paralysis of the seventh and some partial phenomena in the region of the fifth. These symptoms were cured by appropriate antisyphilitic treatment, but nevertheless these cases must be regarded with gravity, for such a condition indicates an invasion by the organism of the central nervous system. Max Nonne relates two examples of isolated right-sided trigeminal neuralgia in a syphilitic. Every case of neuralgia of the fifth, even though the patient is the subject of antecedent syphilis, is not necessarily, indeed is not generally, syphilitic in origin ; it may be due to a general cachexy and a neuropathic disposition or gouty tendency. An antigen sero-reaction would make syphilis more probable as the cause, and especially when other symptoms point to inflammatory affection of nervous structures, for example Case 8, p. 74. Indeed I cannot help thinking the majority of these cases of paralyses or neuralgias due to inflammatory affection of nerves would show a marked increase in lymphocytes in the fluid obtained from lumbar puncture, and this would indicate really a widespread affection, although the obvious symptoms may be localised to one or two cranial nerves.

In none of these cases of neuralgia from syphilitic neuritis are painful pressure points absent at the point where the nerve emerges from the bone or fascia. The branches of the cervical plexus have been known to be affected, and especially the great and small occipital and great auricular nerves. Neuralgia of the brachial plexus is rare. Intercostal neuralgia occurs, also neuralgias of the nerves arising from the lumbar and sacral plexuses, and the commonest seat of neuralgia after the fifth is the sciatic. E. Mendel has reported three cases of sciatica in syphilitic subjects which were promptly cured by mercury. Lang describes a case of sciatica in which he was able to feel the sciatic nerve behind the great trochanter as a greatly thickened nodular band, which disappeared together with the pain after local injections of grey oil. He considers that sciatica is frequently caused by syphilis; in all probability a perineuritis is the cause in most cases. Intractable sciatica in persons the subjects of antecedent syphilis have not infrequently been cured by antisyphilitic treatment.

Acute polyneuritis syphilitica. There is no reason why a polyneuritis should not occur in secondary or early syphilis, as a result of spirochaetal infection, but it would be unjustifiable to diagnose such a condition in a syphilitic subject unless other well-recognized causes can be excluded, e.g. alcohol, over-treatment with mercury or arsenic, lead, diphtheria, Beri-Beri, and auto-intoxication due to liver and renal inadequacy. Cestan states that, after elimination of all cases which are doubtful on the ground of other poisons having produced the neuritis, there remain a certain few cases to which the only assignable cause of the polyneuritis is syphilis; these are cases where the symptoms of polyneuritis come on only a short time after the appearance of the chancre, and either before mercury has been administered or before sufficient mercury has been administered to be at all likely to have occasioned the neuritis. Cestan gives particulars of two cases; in the first the chancre became indurated on May 1. On the 15th the motor troubles are manifested; in the interval the patient had only taken some mercury pills, which would not suffice to cause a neuritis; moreover the mercurial treatment was continued in the form of peptonate of mercury with great benefit. In the second case syphilis was discovered in December, and the motor trouble had appeared in October. The rarity and benignity of syphilitic polyneuritis are such that their morbid histology has not been investigated, but their clinical symptoms differ but little from other forms of neuritis, from which they can be excluded by the symptomatology, e. g. lead, the extensor paralysis sparing the supinator, the blue line, and the history from alcohol by the mental symptoms, and the serum-reaction. The following case reported by Trömner is apparently one of polyneuritis, and illustrates the symptoms which may occur.

A Chinaman, aged 20, two months after he had left Hong Kong by ship developed a universal papular syphilitic eruption, with progressive and increasing weakness of all four limbs and all the signs of a multiple polyneuritis without any evidence of affection of the internal organs. There was a slight paresis of the legs, for all the movements were lacking in power, and there was pain on attempting to move them; there was a weakness in dorsal flexion of the foot and in extension of the knee; the peronei were paralysed, in consequence there was uncertain paretic stepping gait. The weakness of the arms was less marked, but the long supinators were affected. The triceps jerk was hardly obtainable, the leg reflexes were absent, the superficial reflexes of the abdomen, of the sole of the foot and cremaster were greatly diminished. There was tenderness on compression of the nerve-trunks and of the muscles, the legs more than the arms; the nerves were not thickened. There was reaction of degeneration in the muscles of the legs and feet; those of the arms and thighs were normal. There was some light tactile anaesthesia and diminished sensibility to heat and cold on the leg and foot. This is a pretty typical description of polyneuritis, and the question naturally arises, was the syphilis cause or coincidence? The fact of the neuritis occurring simultaneously with the papular eruption is of importance, for the cause of the latter is due to escape into the blood of the living virus ; on the other hand it might be urged that both the syphilis and the eruption were coincidence and the cause of the neuritis was either alcohol, Beri-Beri, or some poison like arsenic or lead. But against the assumption that it was Beri-Beri were the following facts :—the heart was not affected, the general well-being of the patient and the absence of a history of infection. Moreover there was no history of alcohol, and antisyphilitic treatment met with complete success.

For diagnosis of neuritis from spinal meningitis vide p. 176.

THE DIAGNOSIS OF SPINAL CORD DISEASE

As I have before stated on many occasions, it is seldom that the spinal cord is the only seat of a syphilitic lesion of the nervous system, for if the virus gains access to the subarachnoid space the tendency (especially when symptoms arise within a few years of the primary infection) is to affect the base of the brain as well as the whole spinal axis, and many cases which have been sent to me as spinal cord lesions have exhibited previously, simultaneously, or successively, paralytic and irritative symptoms, clearly indicating that the membranes and other structures at the base of the brain were also affected, e. g. paralyses of cranial nerves, particularly various oculo-motor paralyses, headache, slight stiffness of the neck (vide Cases 23, p. 111, 35, p. 167). These symptoms indicate a basic meningitis, but the spinal symptoms are often so obtrusive that, when slight and transitory, these phenomena are frequently overlooked by the patient and sometimes by the doctor. If there be a meningitis, it is highly probable that there is some degree of coexistent cerebral arteritis, which, if it does not cause any symptoms at the time of the spinal affection, may subsequently do so. A patient presenting himself with symptoms pointing to affection of the spinal cord may give a history of antecedent syphilis, and yet not necessarily be suffering from syphilitic disease of the spinal cord. Still it is astonishing how many cases of spinal cord affection in young men are due to comparatively recently acquired syphilis. It is, therefore, necessary either to prove the existence of a syphilitic affection or exclude it ; this can be done by inquiry, by examination of the body for syphilitic residua, and by the Wassermann and lymphocyte reactions. The next thing to be done in making a diagnosis is to show whether the fact of antecedent syphilis bears a causal relationship, or is merely coincidence. It must be borne in mind that there is no clinical symptom or group of symptoms characteristic of syphilitic disease of the spinal cord, but there are certain symptoms which, if they occur in young adults, particularly of the male sex, should make us suspect their syphilitic origin. The early symptoms are spinal irritation, severe intercostal pain worse at night, cramps and contractures of limbs, with pains radiating down them, bladder troubles, disappearance and reappearance of the patellar reflexes, the Brown-Sequard phenomenon ; in fact, symptoms pointing to a local or more *generalized meningitis* or *meningo-myelitis*, but usually without pyrexia, unless there be some complication causing septic absorption. As in cerebral syphilis so in the spinal disease the symptoms are particularly liable to remissions and regressions. One group of symptoms may improve or even disappear, and another group appear, or symptoms may improve in one part of the body while progressing in another. Lumbar puncture would show a marked increase in lymphocytes, and this would serve as a means of differentiation from the symptoms occasioned by the pressure of a new growth spreading up a posterior root, and then injuring the cord by compression. Many years ago, when I was a house physician, a patient, the subject of antecedent syphilis, was admitted, suffering with intense unilateral intercostal pain and weakness in the lower limbs which progressed to paraplegia ; he had also an irregular enlarged painful liver. He was placed on mercury and iodide of potassium, and he rapidly improved, so that he was able to get up and walk ; a gumma pressing on the spinal cord with a syphilitic gummatous liver was the diagnosis made in consequence of the apparent beneficial result of the antisyphilitic treatment. We were, however, quite wrong, the man died nine months later of mediastinal lympho-sarcoma, with huge secondary deposits in the liver ; the cause of the paraplegia was a small deposit on the sixth thoracic dorsal root, which had given rise to the pain and pressure upon the cord, and caused the paraplegia; the tumour had undergone a spontaneous liquefactive process, hence the disappearance of the symptoms.

Tabes Dorsalis.—The commonest affection of the spinal cord resulting from syphilis is Tabes Dorsalis. This disease is one of the easiest to diagnose if it be remembered that in the great majority of cases there exist characteristic pupillary phenomena (vide pp. 323, 324), notably the Argyll-Robertson sign which is met with in Tabes Dorsalis and general paralysis alone. It may be the only evidence of parasyphilis. A patient, however, will not seek medical advice on account of this early and almost constant sign, but for some subjective symptom or condition which produces pain or discomfort. A knowledge therefore of the multiform early symptoms of this disease is essential for its diagnosis in the pre-ataxic stage (vide pp. 323–80). A patient who is suffering with 'locomotor ataxy' is very seldom ignorant of the nature of his complaint; not so, however, a tabetic patient in the pre-ataxic stage, for he may seek relief for the lightning pains which he believes are caused by muscular rheumatism or sciatica. He may likewise consult a doctor for bladder troubles or impotence; for paroxysmal attacks of dyspepsia and vomiting or for difficulty in breathing; for double vision and squint or failing sight; for painless spontaneous dislocation or fracture, not knowing that he is suffering from a serious progressive disease of the spinal cord; but the medical man should in all such cases examine the pupils, and if he finds the Argyll-Robertson phenomenon associated with any one of the above symptoms or conditions, he may conclude that the patient is suffering with Tabes Dorsalis. The patellar and Achillis reflexes are absent in the majority of cases, and this fact serves to confirm the diagnosis, but sometimes one is present and not the other; and occasionally both are present, and yet the patient may be suffering from tabes dorsalis. There is generally some sensory disturbance of the skin and Romberg's sign may be obtained. In doubtful cases an examination of the blood and cerebro-spinal fluid should be made (vide Chapter V).

A very important matter is the differential diagnosis of tabes and pseudo-tabes; the latter may be due (1) to a gummatous meningitis involving especially the posterior roots; (2) to an ataxic form of peripheral toxic neuritis. In both these diseases there may be considerable ataxy and Romberg's symptom may be present. The chief points in making a diagnosis may be summarized as follows :

I *Tabes dorsalis*	II *Pseudo-tabes syphilitica*	III *Ataxic-toxic peripheral neuritis*
1. Average time between syphilitic infection and onset of symptoms ten years. Very rarely under four years. Only slight signs, if any, of syphilitic residua as a rule. Onset and course usually slow, insidious, and progressive.	1. Average time between syphilitic infection and onset of symptoms eighteen months to two years, rarely after four years. Generally signs of syphilitic residua. Onset and course usually rapid and subject to regressions and remissions.	1. A history of some toxic condition, e.g. diphtheria, typhoid, lead, diabetes, and particularly alcohol.
2. Pupil phenomena and strabismus common. Argyll - Robertson pupil rarely absent.	2. Pupil phenomena and strabismus common, but Argyll - Robertson pupil rare.	2. There is pain and tenderness of the limbs, and the gait is ataxic ; there may be paraesthesia, often the muscles may be wasted and give the reaction of degeneration. There is usually foot drop and wrist drop. The pupils are, as a rule, not affected. There are no changes in the fundus : in diphtheria there is paralysis of the muscle of accommodation, the light reflex is preserved. As a rule, there are no bladder troubles unless there is dementia. The knee-jerks may be lost, present, or exaggerated. If there be any doubt, the serum diagnosis with negative result, and the absence of lymphocytes in the cerebro-spinal fluid will solve the difficulty.
3. Primary optic atrophy not uncommon.	3. Optic neuritis and post-neuritic atrophy not uncommon. A unilateral central scotoma, the other eye remaining healthy, is an indication of a retrobulbar neuritis affecting the papillo-macular bundle of fibres ; it indicates gummatous meningitis.	
4. Bladder troubles common, and visceral crises not infrequent.	4. Bladder troubles common.	
5. Knee-jerks absent as a rule.	5. Knee-jerks variable, one day absent and then returning.	
6. Lymphocyte reaction as a rule not marked in the early stages ; it is uninfluenced as a rule by mercurial treatment.	6. Lymphocyte reaction very marked, and disappears with mercurial treatment.	
7. Lightning pains in the limbs. No stiffness in the neck and spine. Girdle sensation may be present, and thoracic anaesthesia to light touch is frequently present in the first stage.	7. Spinal pain, tenderness, and stiffness ; the pains lancinating, radiating from the spine down the limbs. Girdle sensation and thoracic anaesthesia very frequently present.	
8. Positive Wassermann's reaction in 50 per cent. of the cases.	8. Positive Wassermann's reaction less often than in tabes.	

Sir W. Gowers states : '*Acute myelitis* in syphilitic subjects, even if due to syphilis, presents no distinguishing features, nor is its course influenced by antisyphilitic treatment. But the latter fact is true of *all* acute syphilitic inflammations—the tissue destroyed by the process cannot be restored by the removal of the cause.' This statement is true as regards the fact that antisyphilitic remedies will not put back new nervous tissue when it has been destroyed, but that it will not influence the cause of an acute myelitis due to syphilis is another matter ; for the prompt treatment of the syphilis will certainly help to arrest inflammatory change in the membranes and vascular structures.

Myelitis, as a result of syphilis, often follows meningitis ; it may be either focal or diffuse ; it is the diffuse form which is indistinguishable from an acute myelitis due to other causes, e.g. specific fevers, micro-organisms, and microbial toxins.

Retention of urine may precede all other signs. The position and extent of the cord lesion may be inferred from the extent of the paralysis and loss of sensory functions ; the reaction of the muscles to the galvanic and faradic currents will enable a judgement to be arrived at as regards the affection of the grey matter of the anterior horns. Sometimes a *polio-myelitis* may occur as a result of syphilis ; this could be explained by an obliterative endarteritis of the anterior spinal artery ; the symptoms in such a case would resemble the acute spinal paralysis of the adult, especially if it were comparatively sudden in its onset, owing to thrombosis in the vessel affected by syphilitic disease.

Landry's paralysis occurring in the subject of antecedent syphilis might be mistaken for acute ascending myelitis of syphilitic origin, but in ascending myelitis, sensation is affected, and, if the patient survives, there is a great tendency to the formation of bedsores, and many muscles may waste, showing loss of faradic irritability.

In Landry's paralysis there is little or no impairment of sensation, bedsores do not form, and if the disease be not fatal, there is no change in the electrical irritability of the muscles.

If the signs and symptoms point to a focal transverse myelitis we should seek to find whether it is primary or secondary. Myelitis in the acute form may arise from pressure due either to a growth or diseased bone.

The important points are, firstly, root pains which precede usually by some days or weeks the paraplegia; secondly, evidence of disease of the spinal column as a result of caries or cancer; consequently the spine should be examined very carefully to ascertain if there is any bone disease. If there be no sign of bone disease to account for the signs and symptoms of a transverse myelitis, and there is a possibility if not a probability that the patient is the subject of antecedent syphilis, lumbar puncture should be performed, and if the cerebro-spinal fluid contains excess of lymphocytes, the probability, nay almost certainty, is, that the disease is of syphilitic origin, and although the fact of preceding syphilis is of very little influence in the prognosis of acute myelitis, nevertheless it greatly improves the prognosis in a case of transverse myelitis (meningo-myelitis) when it is of syphilitic origin.

It is not uncommon for tubercle and syphilis to exist in the same individual, and cases of syphilitic disease of the vertebrae simulating Pott's disease have been described; some of these cases were no doubt tubercular caries in a syphilitic individual; others were possibly syphilitic disease of the vertebra in a tubercular individual. But syphilitic caries of the vertebra is extremely rare as compared with tubercular disease. The symptoms produced by compression of the inflammatory products are the same; even the Brown-Sequard phenomenon of paralysis of one half of the body with retention of sensibility (often hyperaesthesia) and anaesthesia of the opposite non-paralysed side, does in rare instances occur as a result of unilateral compression due to tubercular disease or new growth. Calmette's reaction might be used in conjunction with the serum diagnosis for syphilis.

Spinal disseminated sclerosis. Perhaps this is one of the most important and difficult conditions to differentiate from syphilitic disease; it occurs in young adults, certainly more often in the female sex. Spastic paresis of the limbs, slurring speech, nystagmus and tremors, transient ocular paralysis, slight facial paresis, some limitation of visual fields and optic atrophy, are a group of symptoms that may resemble some cases of cerebro-spinal syphilis. I recently had such a case in the hospital; it gave, however, neither the Wassermann reaction nor the lymphocyte reaction of the cerebro-spinal fluid. I therefore did not administer antisyphilitic remedies.

Hysterical paraplegia may be differentiated in the same way if there be any doubts.

Spinal Neurasthenia. The subject of antecedent syphilis may be suffering with symptoms of spinal neurasthenia; for the diagnosis, vide pp. 194, 195.

Prognosis. A person with nervous and mental symptoms, who is the subject of antecedent syphilis, may be suffering from either syphilitic or parasyphilitic disease; not necessarily, however, is he suffering from either the one or the other, for, in discussing diagnosis, we have seen that the nervous and mental symptoms may have no causal relationship with the antecedent syphilis. In giving a prognosis the first requirement is to ascertain into which of the following groups we should place the nervous affection from which the patient is suffering: (1) coincident nervous diseases; (2) syphilitic diseases of the nervous system; (3) parasyphilitic diseases of the nervous system. It by no means follows that because we incline to the view, or even come to the conclusion, that the nervous or mental symptoms presented by the patient have no causal relationship to the antecedent syphilis that the prognosis is therefore more favourable. Indeed the etiology of symptoms and pathologico-clinical examination may indicate by negative syphilitic reactions an incurable and even rapidly fatal disease, e.g. non-syphilitic tumours, either primary or secondary, of the brain, septic or tubercular meningitis, non-syphilitic myelitis, in all of which conditions a much more hopeful prognosis can be given, if there are reasons for believing that the syphilitic virus is the pathological cause of the lesion to which the clinical symptoms point. There is no form of nervous or mental disease which may not be coincident with the history of antecedent syphilis, and the hope may be reasonably entertained in many cases that antisyphilitic remedies may be followed by beneficial effects; and with a varying degree of probability a favourable prognosis may be given according to the likelihood (based upon previous experience) of the symptoms clearing up with the treatment. The more certainly the diagnosis points to active syphilis being the direct cause of the symptoms the more favourable is the prognosis in grave organic disease of the nervous system; because, provided the symptoms are mainly irritative phenomena, such as pains or muscular spasms and stiffness, and not paralytic phenomena, the more likely are they to clear up with treatment. If, however, the disease has been allowed to progress untreated, and paralytic phenomena have occurred, it is not likely that drugs will restore destroyed nervous tissue and the prognosis is more unfavourable; all that can be hoped for is arrest of further destruction and restoration of some of the lost function by substitution, that is that other nervous structures undamaged by the disease will, to a certain extent, repair the damage by taking over partially the function which has been impaired or lost. If the diagnosis, therefore, points to meningitis in the early stages the prognosis of a perfect recovery is fairly good, and if the patient is kept under observation and treatment for some years it is probable that the recovery may be permanent; the longer the time that elapses without return of symptoms the more favourable is the prognosis of a complete and lasting recovery; it is, however, well to give a guarded prognosis, for it is astonishing what a long time the syphilitic virus may lie dormant, and when the syphilitic infection is almost forgotten, the latent virus, under some predisposing or exciting cause, e. g. alcoholism, debauchery, physical or mental trauma, finding a *locus minoris resistentiae*, resumes an active state with the sudden or gradual onset of characteristic clinical symptoms. If the diagnosis points to a generalized syphilitic disease involving the vessels and the substance of the brain and spinal cord as well as the membranes with mental and paralytic symptoms, the prognosis is grave; not only is the patient likely to be permanently affected in body and mind, but the disease is likely to prove fatal within a few years. It means a widespread destruction of nervous matter, with secondary degeneration and liability to further destruction by thrombotic softening or encephalitis and myelitis, conditions causing damage which cannot be restored by antisyphilitic remedies; nevertheless it is extraordinary how much improvement may sometimes occur by a mercurial course in a patient who previously has either had no antisyphilitic treatment, or only inadequate treatment. Still even more than in the case of meningitis a very guarded statement should be made as to the future; for cases which *apparently* have made a marvellous recovery, relapse; it almost seems that the spirochaete, once having got into the subarachnoid space, may remain dormant numbers of years, not killed by the mercury but only arrested in activity. Syphilitic meningo-myelitis, localised syphilitic gummata, and gummatous pachymeningitis are the most satisfactory cases to treat, and usually a hopeful prognosis may be given; for the localised process is more readily arrested in its progress by antisyphilitic remedies, and the complications which may arise as a result of the brain and cord disease are less severe and less numerous. It is usually the complications which arise that are the immediate cause of death; therefore the prognosis as to prospects of life largely depend upon the present existence or the probable occurrence in the future of the usual complications in severe organic disease of the nervous system, e.g. broncho-pneumonia from food inhalation, so fatal in all forms of dementia and bulbar conditions; bedsores, especially the rapidly-spreading sacral bedsore occurring in myelitis; the bladder troubles with cystitis and pyelo-nephritis, the most fatal of all complications in nervous disease, especially diseases of the spinal cord of all kinds. But if the prognosis of recovery or death depends so much upon the occurrence of these more or less avoidable complications, it must depend, in a corresponding degree, upon careful treatment and skilful nursing, whereby these complications can be prevented, or, if they cannot be prevented, as sometimes happens, they should be immediately recognized, and not a moment should be lost in endeavours to repair the mischief. The prognosis as to the future also largely depends upon the intelligent treatment of paralysed limbs, so that a patient may not from want of skilful treatment remain helpless and bedridden from contracture of his limbs. Not only, therefore, does the prognosis depend upon the symptoms presented by the patient, but also upon the patience, perseverance, and intelligence of the doctor and nurse, aided by the co-operation of the patient and friends. Should the diagnosis point to a parasyphilitic affection, the immediate danger to life is not so great, even though it is paretic dementia ; but whether it be tabes dorsalis, optic tabes, tabo-paralysis, or general paralysis, the prognosis is bad, because the most that can be hoped for is a temporary, very rarely a permanent, arrest of the symptoms; the prognosis of complete recovery is too remote for consideration ; although, as we have seen, cases occasionally occur in which tabes remains in the pre-ataxic stage a great number of years, yet the tendency is for the disease to progress in nearly all cases of these different varieties of parasyphilis. Alcohol is the great ally of syphilis in the production of nervous diseases of all kinds, and unless a patient, whether suffering from syphilis or parasyphilis of the nervous system, can be kept away from drink and women, the prognosis is bad. One night's debauchery may cost a patient his life. Likewise, in forming a prognosis as to the future, the liability to emotional stress must be taken into account. I have seen many cases in which it appeared to me failure in business, great grief at the loss of a child or wife, has appeared to be an exciting cause of general paralysis in the subjects of tabes dorsalis and optic atrophy.

If a patient suffering with symptoms pointing to tabes or general paralysis has never been treated with mercury, the prognosis may not be so bad as one who has been so treated ; for some authors claim that they have seen great benefit result from mercury in parasyphilitic subjects previously untreated.

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CHAPTER V

PARASYPHILIS (FOURNIER); METASYPHILIS MÖBIUS).

Parasyphilis is the term given by Fournier to those diseases of which syphilis is essentially the cause, but which are not directly the result of the syphilitic virus. The diseases which are generally recognized as such are: general paralysis, tabes dorsalis, tabo-paralysis, and primary optic atrophy. These diseases are really a single morbid entity, owning the same cause, insidious in onset, progressive in character, and uninfluenced by antisyphilitic remedies. These various clinical types of parasyphilitic disease are the result of a primary neuronic dystrophy; they have a similar pathogenesis and may occur simultaneously or successively in the same individual. In tabes dorsalis the spinal sensory protoneurones are affected; in general paralysis the cortical association neurones; in tabo-paralysis both are affected simultaneously or successively. The dystrophic process is due to a lack of durability of the neurones; it may be, as in the case of tabes dorsalis, a slow process of decay and death of the intraspinal portion of the sensory protoneurones; it may be a rapid process of decay and death of systems and communities of neurones of the brain as in general paralysis. The former is a smouldering destruction of neural elements, the latter a conflagration often fanned into flames by circulatory disturbances associated with arterial anaemia and venous congestion and stasis of the brain. It is probable that Erb's spinal paralysis and certain cases of amyotrophic lateral sclerosis may be primary post-syphilitic dystrophies.

Before considering more fully the hypotheses to explain this primary dystrophic process and its relation to antecedent syphilis as a cause, it will be as well to discuss those functional disturbances of the nervous system which not infrequently occur in the subjects of syphilis, and which Fournier includes in ‘ les affections parasyphilitiques ’.

It must be borne in mind that in all functional disturbances of the nervous system the personality of the individual plays an important part—‘ What a man is born with and what has happened to him after birth.’ A fortunate and happy combination of Nature and nurture determines not only the process of resistance to disease but also gives a well-balanced mind, whereby the individual is able to accept even such a shock as the acquirement of syphilis calmly, philosophically, and with moral fortitude. The moral shock to an individual with a neuropathic or psychopathic temperament, when combined with the devitalizing influence of the syphilitic virus, may cause a psychical trauma and lead to the manifestation of various functional neuroses and psychoses. There is, however, as a rule, nothing specific about these neuroses and psychoses, and they do not yield to treatment of an antisyphilitic nature, unless the syphilitic virus is active at the time. In a very large asylum experience, I have seen very few cases of neurosis or psychosis which I could assert positively to be due solely to the effect of the active poison. Those I have observed, for the most part, have been combined with drink; still I have seen a few cases of secondary syphilis with insanity occurring in young adults who, at first untreated, showed no signs of mental improvement, have rapidly improved when treated with mercury. Fournier thus classifies parasyphilitic affections :—

I. *Acquired Syphilis*

1. Acute hystero-neurasthenia of the secondary period.
2. Different neurasthenic manifestations of a more advanced stage.
3. Tabes.
4. General paralysis.
5. A special form of epilepsy.
6. A special form of muscular atrophy.

II. *Heredo-Syphilis.* Numerous dystrophic troubles, general or partial; malformation notably dental, arrest or retardation of physical and intellectual development, infantilism, dwarfism, inborn lack of vitality, cachexia, marasmus, rickets, hydrocephalus, certain forms of simple meningitis in early life, possibly certain cases of true epilepsy, juvenile tabes, spinal and optic juvenile general paralysis. The gravity of these affections lies in the fact that they are uninfluenced by antisyphilitic treatment. The local and general failure of development may be due (1) to the direct influence of the virus upon the life and growth of the tissues or (2) indirectly to exhaustion of the specific energy of the cells of the central nervous system by the establishment of an altered metabolism, the biochemical nature of which is not yet fully understood.

We might provisionally suggest as a hypothesis that in all cases of acquired and congenital syphilis the 'contagium vivum' excites the tissues and fluids of the body to a defensive reaction. The difference in the effects of inoculation may depend upon the virus itself. Some striking examples will be given (p. 246) which apparently indicate that there may be a special neurotoxic virus, and if such instances were more numerous we could hardly believe that coincidence could explain the facts. If, as there is reason to believe, the *Spirochaete pallida* is the 'contagium vivum,' and that, becoming generalized in the lymph and blood-stream, it produces the secondary manifestations, it is a certain amount of chance what tissues will be attacked, for the living agent, swept along in the blood-stream, may become lodged anywhere and, by blocking capillaries, cause a local focus of tissue infection. The existence of a generalized eruption implies virulence of the circulating blood, and experiments demonstrate the fact that the blood is virulent during the eruptive stage; thus Neisser has obtained a positive result by injection of blood into the skin in the chimpanzee, and Roux and Metchnikoff have successfully inoculated a Macaque monkey from the blood of a chimpanzee in the eruptive period. It would be of great interest to know how long the virulence of the blood persists after the generalized eruption, or if the consecutive attacks which may occur even after fifteen or twenty years are explained by the 'contagium vivum' remaining latent in the lymphatic glands or some deep-seated organ. What is the evidence in favour of this view? It is generally admitted that the subjects of tabes and general paralysis are recruited especially from those individuals who have had a mild attack, and who very seldom show any signs or symptoms of tertiary gummatous skin, visceral or bone lesions. Fournier states, ‘ the comparative mildness of the primary constitutional symptoms in those who ultimately become tabetic would almost seem to indicate that, when the syphilitic virus expends itself in severe primary and secondary manifestations, there is less tendency to the subtle poison which proves so disastrous to the nervous system.’

From an experience of over 500 post mortems made on paralytic patients, I have been surprised at the rarity of severe tertiary skin and visceral lesions as compared with the cases of true syphilitic brain disease. Arterio-sclerosis of the aorta is very common in paralytic dementia ; this, however, is now regarded as a parasyphilitic affection. Again, although paralytics in the prodromal stages of the disease often give themselves up to debauchery and sexual congress with loose women, I have never seen or had my attention called to a case of general paralysis among the vast numbers in the London County Asylums that showed a primary sore or a secondary rash. Krafft-Ebing noted the same fact and concluded that the reason was that every paralytic had had syphilis and was therefore immune. He caused this hypothesis to be put to a crucial test. Nine cases of general paralysis were selected that gave no history and showed no signs on the body ; these patients were inoculated with the virus of a typical hard chancre and watched for 180 days. They presented no signs of infection. The only assumption is that they were immune owing to previous infection, and that they possessed an *anti-toxic reaction* power to resist the toxic action of the syphilitic virus. The concordance of this result with the statistical data of antecedent inherited or acquired syphilis in cases of tabes and general paralysis given in the next chapter, led to the widespread acceptance by neurologists of the view that tabes spinalis (locomotor ataxy) or cerebralis (general paralysis) is essentially of syphilitic origin. *No syphilis; no tabes.* Only a few neurologists such as Von Leyden refuse to accept the syphilitic origin of tabes. One of the chief arguments employed against this view is that antisyphilitic remedies are of no avail in preventing the disease or arresting its progress. Moreover, we know that many people develop general paralysis or tabes dorsalis, even though they have been treated with mercury systematically from the primary infection onwards. So much has this impressed some authorities that they have even asserted that over-mercurialization is the cause of the disease in question. The average time which elapses between the primary sore and the onset of tabes and general paralysis is, according to the observations of Schuster, the same in persons who have been thoroughly treated with mercury and those who have either not been treated at all, or only insufficiently. All the facts, therefore, go to prove that the syphilitic virus has in some way or other damaged the durability of the neurones, so that systems or communities die prematurely. It has been observed that Fournier includes other functional and organic diseases of the nervous system among the parasyphilitic affections. We have less knowledge concerning them and their pathogenesis. I have, however, seen cases of general paralysis in which the motor symptoms were most pronounced and the dementia slight, in which all the deep reflexes were exaggerated, and the plantar extensor reflex present on both sides—a *very unusual occurrence* in ordinary paralytic dementia. At the autopsy there was a well-marked sclerosis of the crossed pyramidal tracts without any coarse lesion in the brain and cord to account for it. I have also seen cases of progressive amyotrophic lateral sclerosis occurring in the subjects of syphilis, which appeared to be the result of the progressive degeneration of the whole motor efferent tract from cortex to periphery, and without any sensory disturbance (vide Case 34, p. 164). Some of the cases of Raymond (cited by Fournier, 'Les affections parasyphilitiques') with sensory troubles, viz. rheumatic pains and paraesthesiae, are obviously, from the account given of the appearances of the spinal cord post mortem, cases of subacute gummatous meningitis involving the roots (pseudo-tabes).

The serum diagnosis and the examination of the cerebro-spinal fluid biochemically and microscopically will permit us in future to determine whether syphilis is the essential cause of these degenerations. For every nervous disease, whether functional or organic, occurring in a person who has suffered from syphilis, is not necessarily syphilitic in origin, yet when we consider the profound influence the virus has upon the blood and tissues of the whole body, it is not illogical to assume that any disease, constitutional, functional or organic, occurring in a person who has acquired or inherited syphilis, very possibly may have found a suitable soil for development, owing to the diminished vital resistance of the tissues, occasioned by such a potent and persistent poison as syphilis. Thus syphilis, although not a direct agent in such a case, by its devitalizing influence becomes an important indirect causal factor of the disease in question.

There are many known ways in which syphilis can cause functional disturbances of the nervous system and lead to the development of neuroses and psychoses. The theory of the possibility of the syphilitic virus stimulating the neurones to increased dissimilative action and exhaustion has been shown to have considerable support from recent investigations (vide p. 214). There are, however, other conditions which are well known, viz. the change in the blood and blood-vessels and in the lymph and lymph channels. Long ago, Virchow pointed out that in syphilis there is a diminution of red blood corpuscles and a hyperalbuminosis. Later, Schulgowski, Hafter, and Laacke described a considerable fall in the red blood corpuscle count. In the secondary stage Martin and Hiller, also Letzius, showed that not only is there a diminution in the number of red blood corpuscles, but also an absolute diminution of the haemoglobin content of the corpuscles. Anz found besides the fall in number of the red blood corpuscles an increase of the white, so that one can speak of a relative and absolute leucocytosis. Later observers showed that there was a diminution of polynuclear leucocytes, and that the leucocytosis was due to a great increase of lymphocytes, which increase we may associate with the polyadenitis. Further there is an increase of eosinophils. These changes in the blood in the secondary period increase in intensity with each fresh series of syphilitic manifestations and diminish as they diminish; moreover, the blood changes disappear with the disappearance of the secondary symptoms under antisyphilitic treatment. Fournier long ago described the favourable influence of mercury upon the blood formation; clearly then the mercury, by its influence upon the productiveness of the syphilitic virus, allows a return of the normal haematopoietic formation or arrests a too rapid haemolytic action. The French authorities were the first to call attention to a syphilitic anaemia and to point out that iron had no influence thereon. The ebb and flow of the amount of oxyhaemoglobin is correlative to the flow and ebb of lymphocytes, which might indicate that, with the pouring out of an abundance of lymphocytes from the lymph stream into the blood stream, there was associated a pouring out of the virus that occasioned the irritation and hyperplasia of the lymph cell elements. Hoffmann asserts that he has observed the serum of a syphilitic patient produce immobility and agglutination of the spirochaetes. When the virus can no longer be neutralized by the defensive reaction of the blood serum embolic capillary effects are produced, causing papular eruptions of the skin, mucous tubercles, and occasionally meningitis. Selenew demonstrated blood changes before the outbreak of the secondary exanthem, therefore during the secondary incubation stage. It is probable that before the eruption becomes visible, microscopic changes have occurred in the affected cutaneous capillaries and adjacent skin structures, much in the same way as we know occurs in the primary sore; consequently we should expect a blood change to precede the eruption. The anaemia may be due to a haemolysis owing to an unloosening of lipoid substances (lecithins and cholesterin) from the red corpuscles by the action of some toxic substance of the virus. It may be supposed that the haemoglobin of the corpuscle is covered by a film or membrane formed of this lipoid substance, and the virus acts upon it in such a way as to destroy the membranous film covering the corpuscle, and liberate both the haemoglobin and the lipoid substance into the serum. According to Levaditi and Yamanouchi the lipoids serving for serum diagnosis not only exist in the liver but in other organs, the brain and the red corpuscles. They are probably complex bodies into which lecithin enters largely. The anaemia may, however, be due to interference with the functions of the haematopoietic tissues; in support of this is the fact established experimentally by Neisser that the red marrow and spleen are especially rich in the virus. Since mercury can rapidly improve this blood dyscrasia, it is probable that it does so by arresting the development of the *contagium vivum* in these blood-forming tissues. In congenital syphilitic children haemoglobinuria may occur, and this may be due to the existence of a large quantity of the virus in the blood causing haemolysis of the corpuscles. Many authorities, working at the subject of metabolism in syphilis, have shown that the nitrogen metabolism is altered. Von Boick, Stephanow, Bjelakow, found that the assimilation of nitrogen of food sinks and the percentage of extractives increases considerably in relation to the urea (Max Nonne). This would indicate an altered katabolism. There is, therefore, considerable evidence to show that causes exist in syphilis which render the organs of the body more vulnerable not only to other infective agencies, e.g. tubercle causing scrofula, but also to the evolution and development of neuroses by a devitalizing influence on the tissues and the unloosening of lecithin bodies.

Neuroses and psychoses. The neurasthenia occurring in the secondary period of syphilis is in no way specific in its symptoms, but it may be favoured if not actually induced by the changes occurring in the blood and tissues in their reaction to the poison. But a factor quite as important in its production is the psychical trauma, the effect on the mind of a sensitive person in whom the moral sense has received a profound shock by the knowledge of the acquirement of what he knows is a loathsome, and believes to be an incurable disease. He is morbidly apprehensive, not only of the dangers to himself, but if he should desire to marry, to his wife and offspring; his mind continually dwells upon the subject and he may consult quacks and books; after which he conjures up symptoms which accord with all the dreaded morbid conditions. Loss of appetite, dyspepsia, malnutrition, sleeplessness, and often the attempt to obtain a temporary relief of his mental torture by alcohol and narcotics all add to his nervous prostration and may end in a neurosis or psychosis which has nothing specific in its characters except the syphilophobia. All the symptoms of neurasthenia may appear in an individual who, having a slight abrasion, thinks he has syphilis, and so great an influence may the fear of syphilis have, that it becomes an obsession and leads to *syphilophobia,*—a morbid fear which may impel the individual to commit suicide, and it may even develop into homicidal mania. It is held by some authorities that the 'ripper' crimes have been committed by some *homicidal paranoiac,* who has acquired syphilis and has been impelled by a delusion that he has a mission to rid the earth of prostitutes who disseminate this loathsome disease.

Diagnosis of Neurasthenia in a Syphilitic subject. The subject of acquired syphilis who develops neurasthenia in the secondary period shows the same symptoms as a non-syphilitic neurasthenic. They are as follows :—

1. General malaise of the nervous system, a malaise constituted by a mixed state of excitement and depression.

2. Headache, sometimes with the addition of vertigo, deafness, and a transitory clouding of consciousness, simulating migraine.

3. Disturbed and restless unrefreshing sleep often troubled with dreams.

4. Blurring of vision, noises and ringing in the ears.

5. Variable disturbances of sensibility, especially scattered analgesia, partial and symmetrical, affecting the dorsal region of the metacarpus especially, and in women also the breasts.

6. Various troubles of sympathetic origin, notably local coldness, situated particularly in the extremities, morbid heats and flushings, by sweats, or even a permanent hyperidrosis of the extremities.

7. Febrile attacks of an intermittent or continuous form.

8. Multiple phenomena of nervous depression of a varied and polymorphic character ; of muscular and circulatory lack of tone and asthenia ; of dyspepsia and gastric atony with dilatation and gastralgia ; of constipation from atony of the bowel, loss of sexual power, nocturnal pollutions and premature ejaculation which alarm the patient and lead to an apprehension of oncoming impotence. It has already been mentioned that some of these symptoms of nervousness may be prodromal of a syphilitic meningitis, and

therefore it is of importance to be able to diagnose between the headache and other symptoms of simple neurasthenia and true syphilitic headache of the secondary period, or that premonitory of the encephalopathies due to syphilitic disease of the vessels and meninges. In neurasthenia there is little true pain; there are unpleasant sensations of tightness, heaviness, emptiness, muzziness of the head, but not true pain. In syphilitic disease, on the other hand, the pain is intense, lancinating, boring, tearing; pain which is so severe as to interfere with occupation. It is often worse at night. Neurasthenic headache is generally diurnal, worse in the morning on rising and better at night on going to bed. Antisyphilitic remedies give relief in syphilitic disease, but have no influence in neurasthenia unless the condition be due in the main to a grave anaemia of the secondary period. A syphilitic headache does not last for months or years without some more serious manifestations of organic disease occurring. In neurasthenia there are very many and varied subjective symptoms—largely the result of suggestion—and very few, if any, objective signs of disease.

It is unnecessary to remark how important it is to distinguish the neurasthenic state, spinal and cerebral, from tabes dorsalis and paralytic dementia in the prodromal stages. As regards spinal neurasthenia, the knee-jerks are increased, there are no bladder troubles, and although attacks of giddiness, analgesia, and paraesthesia may suggest to the patient tabes dorsalis, yet no physician would diagnose this disease in the absence of any of the characteristic pupil phenomena, viz. irregularity, inequality, and rigidity, or sluggish reaction to light. Seeing that the causes which lead to cerebral neurasthenia are in the subject of syphilis the very causes which predispose to paralytic dementia, it may be difficult to decide whether a psych-asthenic displaying periods of depression and excitation, especially if he be addicted to chronic alcoholism, is or is not in the prodromal stage of general paralysis, for the pupil phenomena are not so constant in the early stages of this form of parasyphilis as in tabes dorsalis. The examination of the cerebro-spinal fluid biochemically and microscopically will in such a case afford most valuable information; a positive antibody and lymphocyte reaction would mean a grave prognosis of this incurable disease.

A neurasthenic derives the greatest benefit from the consoling influence of the physician, and the excitable or depressed neurasthenic, who has the belief that he is lost, that he is suffering from an incurable and fatal disease, is yet accessible to reason and listens to the advice and consoling words of his medical adviser. But it is of no use trying to discuss with a paralytic who has delusions of persecution; he will not be convinced by your arguments or consoled by your advice. Sometimes it happens that in late syphilitic arteritis, or arterio-sclerosis, headache may be the sole symptom for months, and this condition may occur in a person the subject of neurasthenia, so that only the latter may be diagnosed. If there be a history of syphilis, no harm can be done, however, by a carefully administered course of iodide of potassium with Liq. Hydrarg. Perchlor. and Sarsaparilla or Cinchona. It may or may not be advisable to tell the patient that you are giving such antisyphilitic drugs; each case can only be judged on its own merits.

Fournier states the prognosis is better in those cases when the neurasthenia comes on early; on an average the symptoms disappear in six to eight months. A neurasthenia coming on in the tertiary period and independently of all specific manifestations is much more persistent and always results in a lasting disturbance of the nervous system. According to Fournier this form of neurasthenia belongs to the parasyphilitic affections, and is never benefited by antisyphilitic treatment. The only mode of dealing with it is that applied to ordinary non-syphilitic neurasthenia. The rest cure at sanatoria, hydrotherapy, bromides, electricity, massage, change of environment, distraction by amusement, voyage and travel, moral persuasion and suggestion are indicated.

Epilepsy. Fournier describes an epilepsy corresponding in all respects to idiopathic epilepsy, coming on in persons free from all neuropathic taint, not yielding to antisyphilitic remedies, but modified although not cured by bromides. He asserts that this is a parasyphilitic affection occurring like tabes as one of the late sequelae of syphilis. Fournier gives a typical case which may be quoted with advantage. A young man, aged 25, contracted syphilis. He was treated for nine months and the disease showed no further manifestations. At the age of 45, that is twenty years after infection, suddenly and without the least warning, he fell down unconscious; general tonic spasms, followed by clonic spasms, occurred, with cyanosis, foaming at the mouth, stertor and terminal sleep. The patient, to Fournier's knowledge, for eleven years never ceased to have such attacks of *grand mal*, but far more frequent were typical attacks of *petit mal*. Bromides alone diminished the frequency, and during the whole eleven years no morbid phenomena occurred indicative of any organic lesion. Max Nonne states that he has himself observed a dozen of such cases and admits the parasyphilitic epilepsy of Fournier, but he is unwilling to go as far as the French observer, who thinks that all cases of epilepsy in which the first symptoms appeared after the age of 35 are parasyphilitic. Rumpf expresses himself much more carefully when he says that an epilepsy which appears on that side of 30 and leads in the course of years to motor paralysis only very rarely is not of syphilitic nature. Syphilis is such a common disease, so likewise is the inborn tendency to epilepsy; the former may, therefore, act as an exciting determinant of the evolution of the latter. Again, alcoholism and head injury in conjunction with syphilis may determine epilepsy. According to Max Nonne, Mendel found 5·86 per cent. of 904 cases of epilepsy occurred in persons over 40 years of age; Kohler found, in 1,352 cases, 7·45 per cent. of *epilepsia tarda* commencing after 40 years of age. In all these cases there were no syphilitic individuals. Other authorities, Hasse, Gowers, and Binswanger, have observed cases of epilepsy which have commenced between 60 and 70.

The acceptance of the view that the syphilitic virus may be a cause of epilepsy gains further support by the occurrence of cases in which epilepsy precedes tabes. Max Nonne relates two cases, both of these parasyphilitic affections occurring successively in individuals. A man, aged 45, two and a half years after infection developed general epileptic convulsions, with biting of the tongue and passing water, which occurred three or four times monthly. A year later, primary optic atrophy commenced and lancinating pains in the lower extremities. The tabetic symptoms progressed and there could be no doubt of the existence of a tabetic posterior column degeneration. In a second case a man, aged 40, four years after infection, without any previous sign of nerve syphilis, began to suffer with epileptic fits. Three years later, definite tabetic symptoms, pains, bladder troubles, absence of knee-jerks, pupil phenomena, and ataxy, occurred. In neither of these cases had antisyphilitic remedies any influence on the symptoms. Other neuroses which occur in syphilitic subjects and which are dependent upon a neurotic temperament, excited and aggravated by the effects of the virus upon the constitution and the mental shock of having acquired the disease, are hysteria, migraine, and hypochondriasis. These neuroses improve with judicious treatment. There are no specific characters to these affections, nor is there anything specific in character in the psychoses, paranoia, melancholia, and mania which occur in persons the subjects of active syphilis, except perhaps that their delusions and hallucinations may be coloured by morbid fears associated with the disease or its treatment by mercury. Attacks of mania, as a result of syphilis, point rather to organic syphilitic brain affection; psycho-motor restlessness, increased flow of ideas, and maniacal delirium may occur in gummatous syphilitic cerebral meningitis; but it must be remembered that mania is especially a sign of the onset of paralytic dementia.

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CHAPTER VI

THE CEREBRO-SPINAL FLUID IN RELATION TO SYPHILITIC DISEASE OF THE NERVOUS SYSTEM

THE examination of the cerebro-spinal fluid as a means of diagnosis has become of such great importance that a chapter is devoted to this subject. It has been found necessary to include the serum diagnosis of syphilis and an explanation of the principles upon which this is founded, together with some deductions which can be drawn therefrom relating to the causation of parasyphilitic affections.

The cerebro-spinal fluid normally is a clear fluid like water. It has a specific gravity of 1·006, a slightly alkaline reaction, and is devoid of all corpuscular elements. It contains only the faintest traces of proteid ; it becomes very slightly cloudy on heating, and contains no ferments. The principal constituent is sodium chloride, but it also contains traces of carbonates and phosphates, also dextrose and traces of urea. The average amount of cerebro-spinal fluid secreted *per diem* is 120 to 150 cubic centimetres. It varies in amount in pathological states, being increased when the volume of the brain is diminished ; in general paralysis it may be enormously increased. It is a fluid *sui generis*. Although it resembles blood plasma and lymph in the nature and amount of its inorganic constituents, the only proteid matter which is present is a globulin ; true albumin is absent. It is therefore not an exudation but a secretion of the choroid plexus, and the whole central nervous system being contained in a closed cavity, the cerebro-spinal fluid fills up the ventricles and all the space which is not occupied by tissues or blood ; it thus serves to equalize the pressure and acts as a water cushion, especially at the base of the brain. The fluid is secreted principally in the lateral ventricles, whence it escapes by the *iter* into the fourth ventricle, and thence by the foramen of Majendie into the subarachnoid space. It is continually secreted and escapes along the lymphatics of all the cranial and spinal nerves, arriving thus into the receptaculum chyli and thoracic duct. The drowsy stupor and lethargy which comes and goes in basic syphilitic meningitis may be due in large measure to an internal hydrocephalus produced by obstruction to the outflow of cerebro-spinal fluid secreted in the lateral ventricles by the choroid plexus.

I. *Microscopical examination of the cerebro-spinal fluid.* The operation of lumbar puncture is a simple one, but must be performed with care. With the patient in a sitting position, the back bent well forward, the operation is performed more easily than when the lateral posture is adopted, but in my opinion it is more liable to be followed by unpleasant after-effects such as syncope, vomiting, and severe headache. It is also to be remembered that fatal results have been recorded after lumbar puncture, especially in cases of cerebral tumour. A wise precaution, therefore, is to keep the patient in bed for some hours both before and after the operation. After thoroughly cleansing the skin a large hypodermic needle of about 1½ millimetre bore is introduced from without inwards about ¼ inch from the middle line between the third and fourth lumbar spines. This level is below the cord. The fluid withdrawn may be used for (1) microscopic and (2) chemical examination.

(1) The fluid is shaken to distribute the cells evenly, and a drop is then placed on a Thoma-Zeiss haemocytometer slide and all the cells counted on the whole 400 squares. This number multiplied by ten gives the number of cells in 1 cubic millimetre of the fluid. Several counts should be made and the average taken. The result gives a rough estimate of the number of cells present, but cannot be regarded as being very strictly accurate.

(2) The fluid is then centrifuged and the supernatant fluid poured off. The residue is removed in a capillary pipette, blown on to a slide and allowed to dry. The residue from a normal cerebro-spinal fluid stained with Leishman or Jenner's stain will show at the most only two or three lymphocytes in the field with a magnification of 400 diameters, whereas in progressive parasyphilitic and syphilitic meningitic affections the lymphocytes are

greatly increased in numbers. The amount of lymphocytosis is an index of the activity of the disease ; it can also be used as an indication of the effect of antisyphilitic treatment. I have observed the lymphocytes diminish considerably and the signs and symptoms of the disease diminish correspondingly in cases of syphilitic spinal meningitis. Numerous cases have been recorded illustrating this important fact (vide Case 35, p. 167.)

(3) Alzheimer has evolved the following method for the cytological examination of the cerebro-spinal fluid, which, although more laborious, he claims to be more satisfactory than any other method for the detailed examination of the cellular constituents. Ninety-six per cent. alcohol in proportion to twice the amount of cerebro-spinal fluid to be examined is added drop by drop and well mixed. The mixture is then centrifugalized for one hour at high speed; the supernatant fluid is poured off, leaving behind a small coagulum of precipitated proteid in which the cells are enmeshed. Absolute alcohol, alcohol and ether, and ether are added, each separately, for one hour, to dehydrate and harden the coagulum, which is then gently loosened from the bottom of the centrifuge tube, dropped into thin celloidin, finally into thick celloidin, and sections cut in the usual manner, and stained with Unna's polychrome methylene blue or Pappenheim's pyronin-methyl green. The celloidin should be removed from the sections by alcohol and ether before staining.

Lymphocytosis in tabes and general paralysis does not diminish with antisyphilitic treatment, and this method is therefore useful in differentiating cases of pseudo-tabes and pseudo-general paralysis, both of which may considerably improve with antisyphilitic treatment. Lymphocytosis occurs to a marked degree in sleeping sickness ; it occurs, likewise, in tubercular meningitis, but there are also polymorphonuclears present. But it must be remembered that lymphocytosis occurs in other affections in which meningitis plays no part. Thus it has been found in Landry's paralysis, in the subacute combined degeneration of pernicious anaemia (Ferrier : Purves Stewart) and in herpes zoster (Sicard). It cannot therefore be regarded as absolutely diagnostic of a meningitis ; but it is strong presumptive evidence, and when combined with other facts the existence of a lymphocytosis of the cerebro-spinal fluid is an invaluable sign of the syphilitic and parasyphilitic affections. It is especially useful in deciding between a case of early doubtful general paralysis and other troubles; e.g. a patient suffering with neurasthenia and alcoholism gives some indications which might, on the one hand, be attributed to these conditions, but which might, on the other hand, be consistent with incipient general paralysis. The existence of a definite lymphocytosis of the cerebro-spinal fluid would justify (even in the absence of Argyll-Robertson pupils) a diagnosis of the latter disease and a very bad prognosis.

Micro-organisms. The spirochaetes have not been demonstrated in the cerebro-spinal fluid, although presumably they *may* be there, for once or twice, successful inoculation has been performed on animals. Ford Robertson has claimed that a diphtheroid organism can be obtained by culture. My assistant, Dr. Candler, was unable to obtain micro-organisms of any kind from the cerebro-spinal fluid withdrawn during life. He examined twenty-five cases of general paralysis, and in some of these cases lumbar puncture was done several times; in cases just after a seizure, or during a seizure. Neither did he obtain diphtheroid organisms from the blood.

II. *The chemical examination of the cerebro-spinal fluid.* In general paralysis and to a less degree in tabes there is an increase in proteid. If the presence of lymphocytes and albumin together with haemolysis be observed in the same samples of cerebro-spinal fluid from the same patient, there will be found fluctuations in the degree of manifestation of these reactions in relation to the oscillations of the course of the disease, e.g. remissions, seizures, cachexia, &c. The lymphocytosis, marked at the commencement as well as at the time of the seizures and of consecutive attacks, goes on diminishing in the ascending phase of remissions as well as in the course of terminal cachexia; it may be that in the former case the initial lymphocyte increase has been associated with the lighting up of the affection, whereas in the cachectic phase the power of reaction of the organism has been destroyed. The amount of albumin present is accentuated in an inverse sense with variable increases, whilst the syphilo-positive haemolytic reaction evolves gradually from the minimum to the maximum parallel with the progress of the disease; patients with negative initial reactions have been found positive in later stages; any patient who has given a positive initial reaction has not given any consecutive negative reaction. These antibodies accumulate, then, in the cerebro-spinal fluid in proportion as the process of decay of the neurones proceeds. There is thus a parallelism between the amount of decay of the brain, the degree of dementia, and the positive character of the reaction, that is to say, the amount of this colloid substance which we term antibody. There is no parallelism between the number of lymphocytes and the amount of substances which prevent haemolysis. A strong serum-reaction may coexist with a poor lymphocyte reaction, and the converse is true. Marie says, on the contrary, that there is a striking parallelism between the facts furnished by the serum-reaction of the cerebro-spinal fluid and the albumin reaction, for which he recommends the following method. Mix equal quantities of centrifuged cerebro-spinal fluid and saturated sodium sulphate solution. The reaction is positive when boiling produces an apparent turbidity. Noguchi, however, in experiments on cerebro-spinal fluids from 43 cases of general paralysis, found that there is a closer relation between the increase of leucocytes and that of globulins than between the increase of globulins and the positive reaction to the Wassermann test. In other words, the results obtained by cytological diagnosis and globulin estimation are in good harmony, while the Wassermann reaction was in some instances absent, although the globulin was increased.

III. *The serum diagnosis of syphilis by the Wassermann method.* To explain the principles of this method it is necessary to make a few introductory remarks regarding its origin. Bordet, in 1901, discovered the phenomenon known as, 'the absorption or deviation of the complement.' At about the same time Gengou discovered a similar phenomenon when working with precipitins. Wassermann, Neisser and Bruck, Levaditi, Citron, Plaut, Stertz, and others have applied this method of the absorption of the complement of Bordet and Gengou to the diagnosis of syphilis by the existence of syphilitic antibodies and antigens in the blood serum and cerebro-spinal fluid of persons suffering with primary, secondary, and tertiary syphilis, as well as in the post-syphilitic, parasyphilitic (or late syphilitic) affections, viz. tabes and general paralysis. The epoch-making experiment of Pfeiffer on bacteriolysins may be said to have afforded the foundation of our knowledge of the principles governing immunity. Bordet, by his observations, came to the conclusion that bacteriolysis, by the serum of an immunized animal, was due to the presence of two substances, the one destroyed by heat (thermolabile) present in normal serum; the other (thermostabile) a substance which resisted heat (56° C.) and was only present in the body fluids and blood of an immunized animal. The former is called the cytase or complement, the latter the immune body or antibody (*amboceptor* Ehrlich).

Bordet and others, by experiment, found that if the corpuscles of one animal were injected into another of a different species, these corpuscles disappeared with the production in the serum of a specific haemolysin, analogous to the bacteriolysin; the haemolytic properties of the serum being due to a specific antibody (immune body) linking up the cytase or complement to the corpuscles. This important discovery led to the possibility of the study of the theory of immunity *in vitro* and its practical application to the diagnosis of disease. The same principles determine the production of haemolysins as bacteriolysins, and the solution of experimentally sensitized corpuscles can be used as a precise index of the presence or absence of one of the two unknowns, viz. (1) the antigen; (2) the antibody or immune body. The thermolabile substance, cytase (Bordet) complement (Ehrlich), is contained in normal serum. Bordet holds that there is only one complement in normal serum and, contrary to Ehrlich, that it is not a specific substance for each antigen, but specific for each animal. Bordet has introduced the terms antigen and antibody, the former to signify any substance which, when injected into an animal, will cause the production of an immune serum; the latter to denote the antagonizing substance produced, which is the essential for the immunizing action of the serum. Now if either the antibody or the complement is not present or is removed the specific bacteriolytic or haemolytic action of the serum or fluid is lost. Again, if the antibody in the presence of the complement is linked up to the antigen, both the antibody and the complement will be inactivated. To find out if a given serum or fluid, e.g. cerebro-spinal fluid, contains either the antigen or the antibody is by the experimental inductive method known as *the deviation of the complement.* How is this effected ?

We shall require, first, to immunize an animal against the blood of some other animal of another species ; for this purpose the blood corpuscles of a sheep are injected into the circulation of a rabbit. After several injections the blood serum of the rabbit becomes haemolytic to the corpuscles of the sheep by virtue of the presence in the serum of an immune body plus the normal complement or cytase. The latter can be removed by heating to 56° C. for a half an hour without destroying the former. There is then left in the rabbit's serum the immune body which by itself will not dissolve the washed corpuscles of the sheep. The addition, however, of a small amount of the normal serum of a guinea-pig which contains complement will at once restore its haemolytic properties.

The second part of the experiment is the deviation of the complement or its neutralization, so that haemolysis no longer takes place when the serum of the guinea-pig is added to the immune body and the washed sheep's corpuscles. This is effected by the presence of both antigen and antibody in the fluid to be examined. The serum or cerebro-spinal fluid to be examined is mixed in varying dilutions with a watery (or alcoholic) solution of the liver of a syphilitic foetus which will contain the antigen (lipoid). A small amount of the serum of a guinea-pig is then added, and the total volume made up to 2 c.c. with saline solution. The series of tubes containing these mixed solutions are placed in an incubator at 37° C. for one hour, and then the sensitized blood corpuscles are added (by sensitized corpuscles I mean washed sheep's corpuscles in immune rabbit's serum which has been heated). The mixtures are again placed in the incubator for two hours at 37° C., then taken out and placed on ice over night. The next morning the amount of haemolysis in each tube is estimated. If, on the one hand, antigen (contained in the extract of the syphilitic liver) and antibody (in the serum or cerebro-spinal fluid) have been present they have united with the complement before the addition of the sensitized corpuscles, and no solution of corpuscles will have taken place because the complement has been fixed. If, on the other hand, the immune body (antibody) was not present, then the complement (cytase) has remained free to act upon the sensitized corpuscles and to lead to their solution. A control experiment, using a normal serum or cerebro-spinal fluid, viz. one which contains no antibody, must be used at the same time (vide Fig. 18). In order to make the *antigen* test, the blood serum or cerebro-spinal fluid is used in place of the syphilitic liver extract, and tested in varying dilutions against a serum or cerebro-spinal fluid which has previously been proved to contain antibody in known amount.

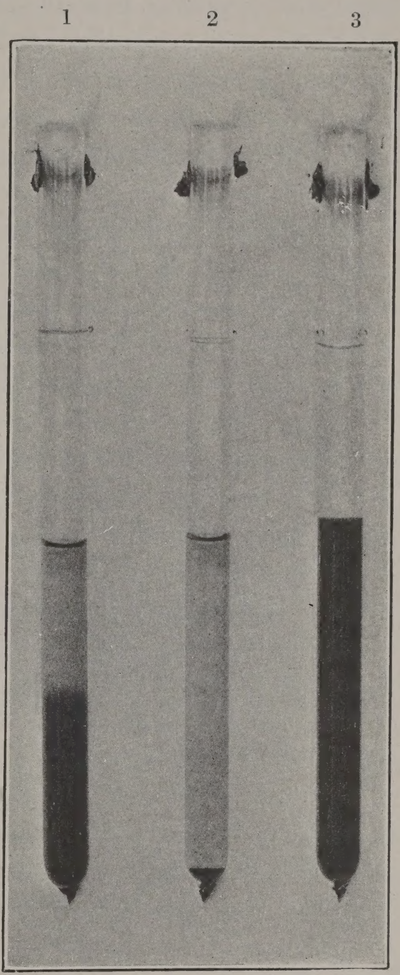

Fig. 18. (1) Cerebro-spinal fluid of general paralysis, showing the Wassermann reaction on removal from the incubator. (2) Ditto, after standing over night on ice. (3) Control with normal cerebro-spinal fluid, showing total haemolysis.

In the hands of nearly all trustworthy and experienced investigators this method introduced by Wassermann has yielded most valuable results as a means of diagnosis. It is even claimed that for general paralysis it is more reliable than the Widal reaction for typhoid. Plaut found the reaction specific ; it is not definitely present in a non-syphilitic individual ; it enables a diagnosis of the constitutional disease to be made, but not the organ affected. He did not obtain the reaction with the cerebro-spinal fluid in twenty-five cases of syphilis in which the nervous system was not affected, while the serum as a rule gave a positive reaction. This is not unexpected from what has already been said as regards the cerebro-spinal fluid and its secretion. It shows that the reaction depends upon the production of some substances by the tissues of the nervous system themselves. The nature and origin of that substance will be discussed a little later, but reference will now be made to the remarkable unanimity of opinion of all those who have made experiments upon this subject as to the almost certainty with which the *cerebro-spinal fluid* of general paralysis, and to a less degree tabetics, gives this Wassermann reaction. According to Plaut the reaction may be negative with the cerebro-spinal fluid in cases of syphilis of the nervous system, but he obtained a positive result in ninety-four out of ninety-five cases of general paralysis with the cerebro-spinal fluid, and in every one of the cases the serum gave a positive reaction. In cases of cerebral syphilis the serum was usually positive, and the cerebro-spinal fluid usually negative; in 70 to 80 per cent. of the cases of tabes the cerebro-spinal fluid gave a positive reaction. Citron, G. Meier, W. Fischer and G. Meier, Michaelis, Weygandt, Fleischmann and W. J. Butler, and others have obtained similar positive results by this method. At my suggestion my assistant, Dr. Candler, in conjunction with Dr. Henderson Smith, of the Lister Institute of Preventive Medicine, has been engaged in applying this reaction to a number of my cases in the hospitals and asylums with the following results.

They have now examined the cerebro-spinal fluid of 100 cases, of which 94 were asylum cases and 6 were in general hospitals. Forty-six cases of general paralysis were examined, 41 of which gave a positive reaction by the Wassermann test, a percentage of 89·1. The reaction was not obtained in any of the control cases. Two cases of locomotor ataxia failed to give the reaction, but it may be noted that neither was in an active stage. A negative reaction was also obtained in a case of syphilitic meningitis in which the cell contents of the cerebro-spinal fluid were diminishing rapidly in numbers under specific treatment. It is also interesting to note that cases of tubercular meningitis failed to give the reaction, although in one case the cerebro-spinal fluid contained a large number of leucocytes per cubic millimetre (vide Table).

AN ANALYSIS OF THE RESULTS OF THE WASSERMANN-PLAUT REACTION ON THE CEREBRO-SPINAL FLUID OF 100 CASES.

Table I.—Showing the Results of 94 Asylum Cases.

	No. of cases.	*Wassermann.* +	*Wassermann.* —	*Percentage of* + *reaction.*	*No. of cases confirmed by autopsy.*
Total number of cases of—					
General Paralysis, examined during life	42*	37	5	88·9 %	4†
(?) ,, ,, ,, ,,	6	—	6	—	—
Non-General Paralysis ,, ,,	16	—	16	—	—
Locomotor ataxia ,, ,,	2	—	2	—	—
Insanity, examined during life (by lumbar puncture)	66	—	—	—	—
General paralysis (post mortem) . .	4	4	—	100 %	—
Non-General ,, ,, . .	24	—	23, 1 doubtful	—	—
Total number of cases examined—					
Post mortem	28	—	—	—	—
Total number during life and post mortem	94	—	—	—	—
Total number of cases of general paralysis, examined during life and post mortem	46	41	5	89·1 %	—

* In six of the above 42 cases of G.P.I., the serum obtained from the blood, withdrawn during life, gave a positive Wassermann reaction.

† The cerebro-spinal fluid of the four cases examined (post mortem) gave a similar result with the Wassermann Test as during life.

Table II.—Showing the Results of 6 Control Hospital Cases.

No.	*Institution.*	*Nature of Case.*	*Wassermann reaction.*
1	Charing Cross Hospital . .	Tubercular Meningitis. (P.M.) . .	—
2	,, ,, . .	Cerebellar tumour (totally blind). (P.M.)	—
3	,, ,, . .	Syphilitic meningitis— 1st examination, cell count 70 per 1 c.m. 2nd ,, ,, ,, 20 ,,	—
4	Victoria Hospital for Children	Tubercular meningitis	—
5	,, ,, ,,	,, ,, ...	—
6	Charing Cross Hospital . .	,, ,, ... (1 c.m. = 100 leucocytes, 8 % lymphocytes).	—

For the purpose of diagnosis, therefore, especially of general paralysis, it is a very important addition to clinical methods. Since its application, however, many doubts have been cast upon the interpretation of the facts, whether indeed the reaction is in any way due to syphilitic antibodies.

Levaditi and Yamanouchi made a study of the diagnosis of syphilis and general paralysis by the Wassermann method. The results of their researches are very favourable from the point of view of clinical diagnosis. Levaditi and Marie have demonstrated the fact that normal liver can replace the syphilitic liver in the preparation of the *antigen*, and the cerebro-spinal fluid of general paralytics supposed to be rich in antibodies was devoid of spirillicide properties. These facts show that the sero-reaction in question, although clinically a specific test for syphilis, had nothing to do with syphilitic antigens and antibodies. Moreover, the active substances of liver extract, syphilitic or normal, contrary to the true antigens, are soluble in alcohol, and the sero-reaction can be obtained with bile salts and with lecithin, although more feebly. The sero-reaction of syphilis and of general paralysis is the same and is not due to the intervention of antibody or syphilitic antigen in the usual sense of the word, and has no relation with the *Spirochaete pallida*. Landsteiner and Porges have also demonstrated that the extract of the liver owes its particular properties for this reaction to the presence of lipoids and bile salts soluble in alcohol at 80° C. These products are found not only in the liver, but also in different organs of man and animals. Landsteiner, Muller, and Potzl state that in syphilitic serum substances are present which in the general sense are not antisyphilitic bodies, but which bind up with certain constituents of normal and syphilitic tissues. Moreover, they assert that the blood serum of animals infected with Tryp. Equiperdum and Tryp. Gambiense contain similar substances called *histaffines*.

Yet being a characteristic reaction, it is attributable to the presence in the serum and in the cerebro-spinal fluid of certain *non-protein* compounds in the colloidal state, which in the presence of bile salts and lipoids of the liver, precipitate and determine the fixation of the complement. The authors consider that these compounds arising in the organism itself may be a cholesterin ester (cholesterin and fatty acid). Thus it will be seen that these authorities give a new interpretation to the phenomena of the Wassermann method, which, however, in no way militates against its value as a practical method of diagnosis.

They also assert that the differences between normal serums and lipoids of the body and specific serums and fluids, are only quantitative and not qualitative, and that the reaction of Wassermann is provoked by histogenic and not bacterial substances. They find, moreover, that lipoids serving for sero-diagnosis not only exist in the liver, but other organs, the brain, the corpuscles of the blood, &c.; they are probably complex bodies in which lecithin largely enters into the composition.

Levaditi, Ravaut, and Yamanouchi have proved that when syphilis leaves intact the central nervous system, although the serum gives a positive reaction the cerebro-spinal fluid does not, and this is as would be expected. It is, however, different when the central nervous system is affected even in a slight degree. The cerebro-spinal fluid can then acquire properties which enable it to yield the Wassermann reaction. In fact in the four cases out of the many examined presenting nervous symptoms, which were neither tabetics nor paralytics, the fluid has twice given a positive reaction, although feeble. The method of fixation of the complement would, up to a certain point, then serve for the early diagnosis of syphilis, especially when the cortex is affected.

The researches of the authors show that there is not any parallelism between the results furnished by the cytological examination and those obtained by the Wassermann method. The leucocyte reaction may be extremely distinct in certain secondary specifics without the cerebro-spinal fluid being in the least able to fix the complement. The penetration of numerous lymphocytes into the spinal canal does not necessarily entail the appearance of substances which in the presence of lipoids engender the phenomenon of Wassermann. Marie and Levaditi have found that there is a parallelism between the rapidity of progress of general paralysis and the degree of intensity of the Wassermann reaction; no doubt, therefore, there is a connexion between the breaking down of nervous substances (destructive metabolism) and the amount of this complex colloidal substance with which probably the reaction is associated and upon which it depends. Porges and Meier found that by addition of lecithin certain substances contained in syphilitic serum are rendered evident by a flocculent precipitate, and they have employed this method in place of the deviation of the complement method. But it is generally thought that this precipitation method is not so specific as the deviation of the complement; moreover, Neubauer, Porges, and Salomon were able to show that syphilitic serum only behaves stronger in this respect than normal serum. Fritz and Kren found that the lecithin test is not absolutely reliable for non-specific diseases, as tuberculosis, leprosy, &c., give a precipitation; still less reliable is the test with glycocholate and taurocholate of soda. In respect to the reaction of Klausner by globulin precipitation it was found that it was more uncertain than the lecithin and bile salts flocculation.

Neisser, Brück, and Stern's investigations are of importance, for they have made a large number of experiments with apes and anthropoid apes, as well as observations on human beings. They conclude that the antigens are not identical with the living virus or of its substance. They do not consider that mercury and atoxyl cause a destruction of the antigen, but that treatment by these drugs injures or destroys the spirochaetes. Moreover, it has been found that antigen exists normally in small quantities in some of the lower apes; it has so far not been found in the higher apes. It is therefore not a new product in syphilis, but it is enormously increased in quantity in this disease. They consider that the serum diagnosis researches prove a direct association of syphilis, tabes, and general paralysis. Immunity to reinoculation occurs when the virus has become generalized in the blood and lymph (Neisser). It is probable that the generalization of the virus engenders simultaneously changes in the properties of the serum by which it becomes capable of giving the Wassermann reaction and preventing reinoculation. There are a number of other reactions which show that a profound biochemical change occurs in the blood in constitutional syphilis. Thus Klausner has shown that distilled water added to syphilitic serum causes a precipitation due to the amount of a precipitable globulin which syphilitic serum contains. Fornet and Schereschewsky have shown that the serum of paralytics and tabetics exclusively give with the serum of syphilitic patients a positive precipitin reaction. It is claimed, therefore, by them that this observation proves the syphilogenous origin of these two diseases.

The simpler method of Noguchi, to which I have been giving attention, consists in boiling two parts of the cerebro-spinal fluid with five parts of a 10 per cent. butyric acid in normal saline solution for a few seconds, and then adding one part of normal caustic soda solution and again boiling briefly. A flocculent precipitate is obtained in parasyphilitic affections. It is due to the presence of a globulin. It is essential that the fluid be free from blood. This test is very useful on account of its simplicity. It will serve to distinguish conditions of meningitis and meningo-encephalitis, whether syphilitic, parasyphilitic, or otherwise, from functional diseases. It is also useful in distinguishing dementia praecox from paralytic and syphilitic dementia. It is not, however, a specific reaction for syphilis ; all forms of meningitis give the reaction.

Summary. The original method of Wassermann is the most complicated, but apparently is regarded by the majority of investigators as the most specific and reliable. Whatever may be the explanation of the facts, all the evidence goes to prove : (1) That these methods in the hands of competent observers afford a valuable means of diagnosis and are especially useful when applied to the cerebro-spinal fluid for the determination of the existence or not of general paralysis. (2) That similar substances, whether antibodies or not, occur in the serum of syphilitic and parasyphilitic persons in quantities such as are not found in the serum of normal persons or in the serum of people suffering with other diseases. (3) That similar substances are found in the cerebro-spinal fluid of tabetics and general paralytics, and the amount of these substances which cause a deviation of the complement or a precipitation is in proportion to the activity and length of duration of the disease ; that these substances are lipoids and globulin; they are of tissue origin or arise from tissue destruction caused in some way by the action present or past of the syphilitic virus. (4) It is conceivable that the syphilitic virus excites an increased unloosening of complex substances containing lecithin, cholesterin esters, &c., from the red corpuscles and cells of the body. (5) This prevails throughout life, and in certain cases of syphilitic infection, viz. general paralysis and tabes, the central nervous system, which under ordinary circumstances is protected against the loss of its lipoid substances, takes part in the process, and this is manifested by the presence of lipoids and globulins in the cerebro-spinal fluid, and these act as the antibodies in the reaction. This complex lipoid as well as a specific globulin increase in amount as the process of neuronic decay proceeds. It is possibly owing to the presence of these substances that the granulation of the ventricles, so characteristic a feature of general paralysis, arises, as a result of stimulation to proliferative hyperplasia of the ependymal epithelium. Choline may also be present, owing to decomposition of lecithin, but this may occur in any active degeneration of myelin, and is not pathognomonic of any particular disease. The subject is more fully discussed in the author's Morison Lectures, published in vol. iv, *Archives of Neurology and Psychiatry*.

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CHAPTER VII

THE ETIOLOGY OF TABES

TABES DORSALIS, TABES OPTICA, TABO-PARALYSIS, GENERAL PARALYSIS

IN a previous section reasons have been given why these diseases are to be considered as one morbid entity, one pathological process affecting different parts of the nervous system. It is only within quite recent times that experimental proof has come to strengthen and confirm the belief of many neurologists like myself of '*No syphilis, no tabes*', based solely upon statistics and observations relating to the etiology of the disease. Moreover, the etiology and the serum diagnosis are reciprocally supporting not only of the parasyphilitic theory, but also of the view that there is one morbid entity which may be described as tabes,—a view first put forward by Fournier and which I have supported by comparing the clinical notes, and in a large number of instances the post-mortem results (with microscopic investigation) of sixty cases of tabes dorsalis and sixty cases of tabo-paralysis. I came to the conclusion that Fournier was justified in asserting the identical relation of the etiology, the close relationship and overlapping in the symptomatology and pathology, and he was right when he destined them one day or other to be grouped in a single pathological entity; for Ferrier, in his admirable Lumleian Lectures on tabes dorsalis, says: '. . . and here I would express, in concurrence with Fournier, Mott, and many other neuropathologists of the present day, my belief in the essential pathological identity of tabes and general paralysis. They are, in my opinion, merely different aspects of the same polymorphic disease.' Both are tabetic or wasting affections, of the sensory protoneurones in the one case, and of the cortical neurones in the other. The essential etiological factor is the same, and the average time elapsing between the primary infection and the onset of the degenerative process corresponds in the two diseases. Fournier remarks that the establishment of the syphilitic origin of tabes dorsalis from his experience would necessarily end in the application of the doctrine to general paralysis. In fact there are so many symptoms in common and so many analogies of evolution and termination associate these two diseases, that it was quite natural to conclude from the etiology of one, the etiology of the other.

Historical Introduction. The possible relation of syphilis and general paralysis was expressed by Esmarck and Jessen, 1857, more than half a century ago. Then Kjelberg of Upsala, 1863, put forward definitely the opinion that general paralysis recognized syphilis always and invariably as a cause. But no one paid any attention to this bold proposition of Kjelberg, although the fact that syphilis had long been a notifiable disease in Sweden necessarily enabled the causal relationship of the two diseases to be more easily ascertained. The mild character of the secondary and the absence generally of noteworthy tertiary symptoms were doubtless reasons which led to the prolonged opposition to the syphilitic doctrine. Although as early as 1863 Eisenmann and Topinard both expressed the opinion that syphilis was probably the cause of tabes, it was not recognized until Fournier in 1876 brought forward a series of 30 cases of tabes in which syphilitic antecedents were proved in 24. The new doctrine was received with scepticism by the majority of the profession; Westphal, 1881, not only said that it was not proved, but also that it was not probable that syphilis was the cause of tabes. Vulpian supported Fournier and the latter collected more cases, and in 1882 brought forward 103 cases of tabes, 99 of which had suffered with syphilis, i.e. over 90 per cent.; later he increased the number to 146, with 93 per cent. Fournier, and those who followed him in establishing the causal relationship of syphilis to tabes, recognized that they were not dealing with tertiary syphilis, but a post-syphilitic manifestation termed by Fournier *parasyphilis*, and by Möbius *metasyphilis*. Erb, in Germany, and Sir William Gowers, in England, began collecting cases, and Erb, who at one lime, 1878, was a strenuous opponent, after putting together a vast collection of statistical facts, became its most strenuous supporter. These statistics of Erb are so convincing that it will be well to quote his latest communication on this subject. Of 1,100 male cases of tabes among the better classes 89·45 per cent. had had chancre or, definitely, syphilis, and thus only practically 10 per cent. had not been ostensibly infected. But of these, in only 3 per cent. was it not possible to find any grounds at all for suspecting an antecedent syphilitic infection. Erb contrasts these statistics with 10,000 obtained from the same class of people and suffering with all varieties of disease, excluding tabes. Of these 10,000 only 21·5 per cent. had had syphilis, that is, syphilis was found 4·5 times more frequently among tabetics than among other patients. Similar investigations were made upon 138 tabetics of the lower classes, and these gave naturally a somewhat lower percentage of syphilitic antecedents, viz. 77·2 per cent. As a contrast he took 1,100 cases of the lower classes non-tabetics, and 6·54 per cent. had had syphilis as against 93·46 per cent. non-infected. Erb remarks that it is much more difficult, for obvious reasons, to determine syphilitic infection in women, but he found among tabetic women of the better class at least 86·7 per cent., and probably 93·3 per cent. had been infected. Among sixteen women of the lower class syphilis was probable from the history in 68·7 per cent., and unproven in 31·3 per cent.

These statistics, collected on so large a scale and by so careful an observer, are very convincing; for although in 10 per cent. of the cases syphilis is unproved, yet should we expect to find it in every case? as well might we expect to find a history of infection in every case of post-diphtheritic paralysis or scarlatinal nephritis. Moreover, Hirschl found that of sixty-three patients suffering from gummatous affections of undoubted syphilitic origin, he only obtained a certain history in 54 per cent.; it was probable in 9·5 per cent., while in 36·5 per cent. there was no evidence of hereditary or acquired syphilis except the objective signs on the patient. The same results were obtained by him in reference to general paralysis. Dr. Pernet, in the late Dr. Radcliffe Crocker's Clinic, was unable to obtain a history of infection in more than 80 per cent. of obvious syphilitic skin affections. An important link in the chain of circumstantial evidence upon which the syphilitic origin of tabes dorsalis and general paralysis is supported is the etiological identity of these two diseases. In studying the pathogenesis of the one disease, you are so often and in so many different ways brought into relations with the pathogenesis of the other, that there can only be one conclusion, and that is, that if syphilis is the causal factor of one disease, it is of necessity the causal factor of the other. As I have made a long and special study of this correlation I shall give a revised account of the same contained in my article on 'Tabes in Asylum and Hospital Practice', *Archives of Neurology*, vol. ii, which deals with the etiology of tabes used in its widest sense.

Etiology of tabes, tabo-paralysis, and general paralysis. The great difficulty which has presented itself to most men who have investigated this subject has been to decide what is to be considered sufficient evidence to warrant the assumption of syphilitic antecedents. The fact that tabetics and paralytics as a rule have the disease in a mild form, and seldom present tertiary residua, together with the fact that neither disease yields to antisyphilitic remedies, seemed so much against the syphilitic origin of these diseases, that little attention was paid to obtaining a history of syphilitic antecedents. Before I was appointed Pathologist to the London County Asylums, syphilis was not mentioned in the reports as a cause or possible cause of the most terrible and fatal of all mental diseases, which is strange, seeing that considerable attention had been given to the subject abroad, and a few authorities in Great Britain, especially Savage and McDowall, had associated syphilis with general paralysis. Since my attention was called to the subject, the percentage of syphilitic antecedents in general paralysis in the reports of the London County Asylums has increased in a striking manner; notably is this the case in the reports of some of the newer asylums, e. g. Bexley. Fournier, Max Nonne, and many other authorities have been struck by the fact that as interest in this question increased, those authorities who had previously found only a small percentage of tabetic patients suffering with syphilis, were led as the inquiry progressed to augment their percentages; thus Berger's statistics rose from 20 to 43 per cent.; those of Bernhardt from 21 to 60 per cent.; Oppenheim's from 17 to about 80 per cent.; and Rumpf's from 65 to 80 per cent. It has long been recognized that general paralysis and tabes dorsalis are rarely met with in women of the better classes, and when they do occur a history of syphilitic infection can usually be obtained. In the lower classes the proportion of males to females in asylums suffering with general paralysis is about three or four males to one female. If we judged from Erb's and Gowers' statistics we should believe that as regards tabes dorsalis the proportion of males to females was about ten to one. In my hospital experience I have not seen many tabetic women, but I was surprised when I visited the Poor Law Infirmary hospitals to find nearly as many bedridden incapacitated female tabetics as male. A large number of these women were suffering from arthropathies. In the cases which I collected of tabes dorsalis, the proportion of males to females was about the same as in general paralysis, viz. three or four males to one female. The statistics of Blaschko are very interesting in this respect; he found that in a population the number of men affected with syphilis was in the ratio of four males to one female, and this corresponded to the ratio of male paralytics to female paralytics for the same population. Furthermore, he found practically the same proportional relationship of percentage of syphilis to paralysis in town and country populations; the rise of percentage of syphilis in the former class of the population being associated with a rise of percentage of general paralysis, and the converse fall in country population being associated with a fall in percentage of paralysis.

Minor's comparative observations in Jewish and non-Jewish Russians are also of interest. He showed that among 4,700 non-Jewish Russians 2·9 per cent. were tabetics; on the other hand, among 698 Jewish patients suffering with nervous diseases, only 0·8 per cent. were tabetics. Functional nervous diseases are extremely common among the Jews, and yet tabes is comparatively rare. This may be explained by the fact that the Russian Jews are less liable to become infected with syphilis. Minor also has shown that both tabes dorsalis and syphilis are five times as common among the non-Jewish Russians as among the Russian Jews.

Statistics of syphilis in 75 *cases of tabes.* In my own statistics there were 57 males and 18 females. Of the 57 males, 43 (75 per cent.) certainly had syphilis, 14 were doubtful, 3 owned to gonorrhoea, and 2 to soft sore. 9 denied infection, but only 1 of these was able to say that he had not been in the way of getting it, and this man was probably a congenital syphilitic, for he was blind from optic atrophy and his case had been diagnosed at St. Bartholomew's Hospital as locomotor ataxy when he was 19. In all the cases which I have seen in private practice I have obtained a history of syphilis, and in nearly all my hospital cases ; but the cases at the infirmaries were patients who, in many instances, were unable to give reliable histories. In women this was especially the case, and one had to judge rather by the history of miscarriages, abortions, and still births, the existence of antecedent syphilis. All the cases, with one exception, were either married women or women who had had sexual congress ; the exception I refer to was probably a congenital syphilitic, for she suffered from optic atrophy before she was 20.

I have found that about 10 per cent. of the cases of general paralysis are of the tabetic kind. Byrom Bramwell (' An Analysis of 263 Cases of Tabes ', *British Medical Journal,* March 21, 1908) states that 11·4 per cent. of his cases of tabes dorsalis become paralytics, and I have found in an analysis of the deaths at Claybury, during the last ten years, that in about 10 per cent. of the 500 fatal cases of general paralysis a well-marked sclerosis of the posterior columns occurred. In about 4 per cent. there was optic atrophy, visible grey degeneration of the nerves, commissures, and tracts. All cases of tabes that come into asylums are not tabo-paralytics; although nearly all those that *die* in asylums are. I have seen cases of tabes with delusions of persecution and with hallucinations that have recovered and been discharged. The majority of cases of tabes admitted to asylums are, however, tabo-paralytics, although this fact may be overlooked if a microscopic examination of the brain be not made, for, as a rule, the wasting of the brain in these tabo-paralytic cases is not nearly so marked as in ordinary general paralysis. I collected 62 cases of asylum tabo-paralysis; in some the spinal symptoms were the first manifestation of the disease, in some optic atrophy, and in some the cerebral symptoms; frequently the advent of cerebral symptoms to a spinal case led to the arrest of the spinal symptoms and their obscuration. The study cf those 62 cases, in the majority of which not only a post-mortem examination but also a microscopic examination was made, convinced me that these cases formed a connecting link between the spinal form and the cerebral form of the disease, and there is no boundary line to be drawn either in the pathogenesis or the pathology of the *two* clinically recognized diseases.

Statistics of syphilis in 62 *asylum cases of tabo-paralysis.* Of 54 male tabo-paralytics and insane tabetics, 46 of which I personally examined, there was a history of syphilis or signs of syphilis on the body in 75 per cent. In 4 cases there were no notes obtainable, and I did not see the cases during life. In 4 there were doubtful signs or history. In 1 case there was no history, no signs on the body, and a healthy family; but, as every one knows, this does not exclude *absolutely* a syphilitic infection. There were 8 women. In only 2 were there definite signs on the body; the histories of the remaining 6 made it almost certain that they had been infected. It is interesting to note that 4 had husbands who suffered with tabes or general paralysis themselves. The following table shows the birth-rate of tabic and tabo-paralytics.

<table>
<tr><th></th><th><i>Children alive.</i></th><th><i>Born alive but died in infancy or afterwards.</i></th><th><i>Born dead.</i></th><th><i>Miscarriages.</i></th></tr>
<tr><td>Twenty-five females married or cohabited with men. Ten of these were sterile</td><td>10</td><td>10</td><td>19</td><td>32</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">51</td></tr>
<tr><td>Fifty-four married males .</td><td>151</td><td>75</td><td colspan="2">52</td></tr>
</table>

One woman was probably infected by her husband after marriage and after she had had a number of living children. Both husband and wife died at the age of 64; in both cases the onset of the disease occurred at the age of 62, and the husband, who first showed signs, died first. This woman had eighteen conceptions (the notes state), and of these seven children are alive; the remainder were either still-born, miscarriages, or died in infancy; the history and the late onset of tabo-paralysis in this couple make it probable that the husband infected the wife late in life, and after she had borne seven children. So that, excluding this patient, the remaining twenty-four tabetic married women had only three children living. Of the others, one had a living child after ten years of married life; she did not know that she had had any miscarriages, and there were no signs of syphilis on the body. The above table shows a remarkable contrast between the effect on the birth-rate of male and female tabetics and tabo-paralytics. But it must be remembered that in the latter case both father and mother are syphilitic, and in the former the father marries in most instances after the virus has become attenuated, or at any rate if the foetus is syphilized the mother escapes manifest effects. The history of a number of these tabetic women left no doubt that they had lived with men but had not been married.

It was said that prostitutes did not suffer with general paralysis or tabes. Since the great bulk of the cases occur, as we have seen, in the fourth and fifth decades, when it is not so easy for a woman to earn her living by prostitution, she is not described as such upon entering the hospital or asylum; and I have found a number of such women in the asylums calling themselves married women, or as following some occupation. The oldest of all professions finds no place in the official records of the asylums, yet if we consider the vast army of prostitutes in London, a very considerable number must find their way into the infirmaries and asylums. Kron's observations upon 184 public prostitutes showed five with tabic symptoms at the ages of 27, 28, 47, and 55. But if we select from the 184 only those over 25 years of age, which would allow nine years to elapse from the time they were probably infected, we should only have to reckon thirty-six women, and of these five suffered with tabetic symptoms, or 14 per cent. of these syphilitic prostitutes suffered with tabes, which is far from a low estimate. I have frequently observed women under 30 suffering with general paralysis in the asylums, and their history often pointed to the fact that they were prostitutes; the youngest I have seen, a prostitute aged 22, was the daughter of a prostitute; she was either a congenital syphilitic or had been infected very early in life. Nearly 50 per cent. of the female general paralytics dying at Claybury Asylum showed non-tubercular salpingitis, whereas in other cases not more than 12 per cent. showed this condition, an indirect proof of syphilitic infection, because it indicates in a large number of instances venereal disease, and the possibility of having acquired syphilis.

Several male cases were of interest because of a definite history of infection occurring after marriage; in these cases miscarriages and abortions followed healthy children. It will be observed that more than 30 per cent. of the married women were sterile. Mendel found that in 252 married female tabetics 32·9 per cent. were childless. A large proportion of these women showed no signs of syphilis on the body, neither could a direct history of infection or secondary symptoms be obtained; but the history was very striking in many of the cases. Dr. Bailey, of Hanwell Asylum, investigated the histories of 118 general paralytic women admitted to that institution; he found that 34·5 per cent. were sterile, which is almost the same percentage as that of Mendel for tabetic women. The statistics of Spencer Wells, Simpson, and Sims, as well as those of Guttstadt, show that married women are sterile in 10 to 15 per cent. of the population; therefore, in paralytics and tabetics, sterility is nearly three times as frequent an occurrence as the average.

The textbooks teach that tabes occurs very much more frequently in men than women, e.g. Erb's statistics indicate 19·5 males to 1 female, Fournier 26 to 1; Kowschewnikoff 11 to 1; Moczukowsky 15 to 1. Mendel's statistics at his Polyclinic in Berlin show the following facts: Number of patients, 20,539 males, 21,825 females; total 42,364. Of these there were 725 male tabetics (3·53 per cent.) and 288 (1·31 per cent.) female tabetics. There was, therefore, 1 tabetic woman to 2·7 tabetic men. He came to the following conclusions. The frequency of tabes in the female sex is essentially the same as progressive paralysis among the poorer classes, where a proportion of about

3 men to 1 woman occurs, whilst in the well-to-do, the proportion is increased to from 5 to 10 men to 1 woman (Max Nonne). The statistics of Byrom Bramwell show that more than 90 per cent. of his 263 tabetic cases were males. No doubt a large number were private cases.

Conjugal tabes and paralysis. Mendel, a supporter of the syphilitic origin of tabes and paralysis, published 5 cases of paralysis and tabes occurring in married couples, and Raecke published 7 of his own cases, and he gives a table with a complete literature of 69 cases. In my research on tabes and tabo-paralysis, which included 60 cases of each, I came across 6 cases of conjugal affection. Moenkemöller found that in 741 paralytics admitted to Herzberge Asylum during six years, there were 17 conjugal cases in which both husband and wife suffered with one or other of these parasyphilitic affections. Of these 17 cases, in 14 both husband and wife were affected with paralysis; in 7 of these, however, one or other suffered from tabo-paralysis, and in 2 the husband suffered from tabes and the wife from paralysis; in 1 the husband suffered from paralysis and the wife from tabes. The husband was first affected with signs of the nervous disease in 13 cases; in 3 cases husband and wife were affected simultaneously; in 1 the woman (a prostitute) was affected first. The proportion showing a history of syphilis is not reliable, owing to the fact that the notes were made at different times by different observers. The statistics, however, are valuable, as they show two facts, viz. that the percentage (2·5) of married couples affected is about the proportion of people who have acquired syphilis and subsequently develop parasyphilis, so that this fact of married couples suffering with parasyphilis cannot be adduced as a valid argument in favour of there being any special neurotoxic virus. Secondly, it shows that the husband generally suffers first with the nervous affection, because he acquired syphilis first and subsequently infected his wife. One of the cases recorded was particularly instructive. The husband was infected in 1876. He married in 1879, and in 1880 the wife gave birth to a daughter who suffered from congenital syphilis. In 1894 the husband first showed signs of tabes. In 1895 the daughter, aged 15, first showed signs of paralytic dementia, and two years later the wife was similarly affected.

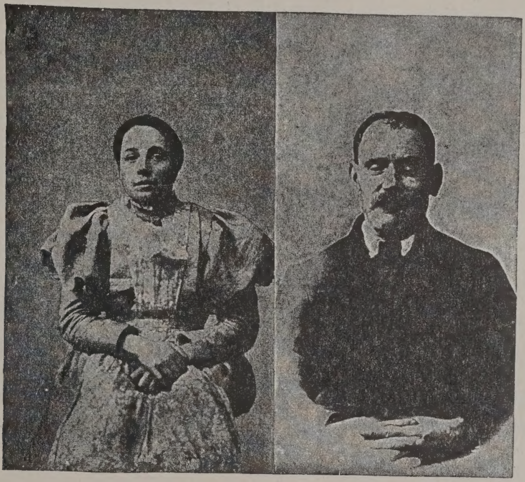
In all the 6 cases I have recorded of tabes and tabo-paralysis it was probable that the husband suffered first from syphilis and infected the wife. In 5 the symptoms commenced first in the husband. Syphilis, or signs of it, was observed or indicated in either husband or wife, or both, in every case. This conjugal affection becomes an important argument in favour of (1) the syphilitic origin of the disease; (2) the effect of mental strain and worry in inducing the disease in one of its forms; (3) the fact that one of the pair may be affected with tabes and the other with paralysis or tabo-paralysis supports the view of the unity of the two diseases, tabes dorsalis and general paralysis, engendered by the action of the syphilitic poison.

The following notes of the male case and the post-mortem examination show the probability that the man at some time or other had suffered with a basic syphilitic meningitis and a lesion of the left paracentral lobule, possibly due to an endarteritis of a branch of the anterior cerebral. This would account for the appearances of the base of the brain observed at the autopsy; it is difficult to decide whether the case was really one of tabo-paralysis or a pseudo-tabo-paralysis. It was certainly of syphilitic origin and the granulation of the ventricles and the spinal roots together with the posterior column changes indicated that it very probably was also a parasyphilitic affection. The presence of the knee-jerk on the side of the sclerosed lateral column is interesting.

Case of conjugal paralysis. Husband syphilitic, wife married twice, no children by second husband; the former died of tabo-paralysis, the latter a short time after of ordinary paralytic dementia.

Case 36. A. B., aged 43, docker, admitted to Cane Hill Asylum, July 19, 1899.

History. Patient became gradually blind about two years ago, and subsequently suffered with locomotor ataxy, for which he was admitted to an infirmary, where he remained one year. He then developed an attack of acute mania, becoming restless, excitable, and violent, threatening to stab another patient; he was certified insane. On admission to Cane Hill it was found that his wife was already in the asylum suffering from general paralysis. The following facts were elicited from friends: He did not drink, nor was there any hereditary history of insanity obtainable. He lost his sight gradually, and this was followed by drooping of the left eyelid, his mental state denoted considerable dementia and loss of memory, with defective knowledge of time and place; he had no delusions of grandeur or persecution, but was restless, noisy, and delirious, and although blind, had *frequent visual hallucinations.*



A case of Conjugal Paralysis.

FIG. 19. The physiognomy of the man denotes mild exaltation and dementia, that of the woman slight depression.

Physical condition. He has a fatuous expression, the face is congested, the skin greasy, and there is incomplete ptosis of the left eye (vide Fig. 19). The pupils are unequal, dilated, and irregular; there is primary optic atrophy of both disks and there is tremor in the lips and tongue, but not marked; the speech is somewhat hesitant and slurred; his gait is shambling; he brings his heels down first and he walks with a wide base, but there is no marked ataxy; the knee-jerk is *present on the right side, absent on the left.* He is too demented to give any reliable answers in regard to cutaneous sensibility; there are well-marked signs of syphilis on the body in the form of a scar on the glans penis, enlarged inguinal and cervical glands and tissue-paper scarring all over the trunk and limbs.

When asked about his wife, he says he does not know where she is and doesn't want to ; she was brought to see him and she was much affected, but he was quite indifferent and told her to go away ; he became more demented and died in December, 1899.

Case 37. E. B., his wife, aged 39, had one child by her first husband, but no children by her present one ; her illness began with a fit a short time before admission ; she was taken to Guy's Hospital and thence to the Infirmary, has had no fits since.

Mental condition. She exhibits considerable dementia and is depressed, especially about her husband ; the photograph shows this in her expression as compared with that of her husband.

Physical condition. Pupils equal, react to light sluggishly ; react well to accommodation. She can walk about, tries, though feebly, to make herself useful in the ward. Tremor of the tongue and lips, and slight paresis of the right side of the face. Speech is very tremulous and syllabic. Knee-jerks exaggerated both sides. The disease progressed, patient becoming gradually more demented ; the tremor and speech affection more marked. The mental depression gave place to mild exaltation, and eighteen months after admission she died from exhaustion, following epileptiform seizures.

Post-mortem notes (abstracted). An old scar found on the outside of the right thigh (? gumma), and cicatrix on the cervix uteri were the only signs which could possibly indicate syphilis. Body—well nourished; Brain—dura-mater, non-adherent; considerable amount of fluid in subarachnoid space. Left hemisphere weighed 14 ozs., right hemisphere weighed 17½ ozs. The wasting of the left hemisphere was especially marked in the prefrontal and central convolutions. The same applies to the right, but less marked. The pia-arachnoid is thickened, adherent, and opalescent. Both lateral and fourth ventricles are granular, and the left ventricle is much larger than the right, corresponding to the difference in weight of the hemispheres. There is early atheroma of the aorta, but the cerebral vessels are normal.

Post-mortem notes of A. B. (*husband*). Died five months after admission. Abstract:—Brain; pia-arachnoid thickened, especially over the frontal and central convolutions; atrophy of the left superior parietal lobule. Over the inferior surface of the orbital lobes on both sides, the brain substance, and the pia-arachnoid covering it, has an appearance not unlike that of a cirrhotic liver; on the mesial surface and tips of the prefrontal lobes there is marked pia-arachnoid thickening and wasting of the convolutions. The lateral ventricles are not much dilated; the ependyma is somewhat granular; the fourth ventricle is dilated and very granular; Broca's convolution shows very little wasting; the pia-arachnoid strips with few erosions, the grey matter of the cortex is diminished, and in the lower part of the central convolutions the cortical striae are ill defined. Both optic nerves are greatly wasted. Left hemisphere weighs 19 ozs., right 19½ ozs. Pons, medulla, and cerebellum 7 ozs. The aorta was markedly atheromatous.

Death was caused by gangrenous pneumonia.

Microscopical examination of the brain (by Nissl, Marchi, Marchi-Pal and Weigert methods). Sections were taken from (1) ascending parietal, (2) second and third frontal, and (3) orbital. *Summary of results.* The changes are mostly of a chronic degenerative character in all the areas examined; few cells were acutely changed. The most marked acute changes in the cells are in the orbital region, where the vascular changes in the form of stasis and perivascular cell proliferation are most pronounced. The neuroglia cell proliferation is nowhere very marked. Recent degenerated radial fibres are seen in the central convolution by Marchi method, but none in the tangential or supraradial fibres. By the Marchi-Pal and Weigert methods these layers of superficial association fibres are greatly diminished or absent in all those regions examined. The changes correspond to an ordinary slowly progressive case of dementia paralytica.

Examination of the spinal cord, ganglia and roots (by Marchi, Weigert-Pal, and Nissl methods). By the Marchi method, sections of the cord in the cervical region at different levels showed a large number of degenerated fibres scattered about in the posterior columns, also in the crossed pyramidal tract on the right side and the direct of the left, showing that there was a recent degenerative process occurring in the brain.

Different levels of the cord in the cervical, upper, middle, lower dorsal and lumbo-sacral regions were examined by the Weigert-Pal method. Sclerosis of the right crossed pyramidal tract and of the whole posterior median column was found in the cervical region. In the dorsal region there was degeneration in the postero-external column corresponding to Charcot's root zone. This was especially obvious below the eighth dorsal. It seemed in this region that the degeneration and atrophy of fibres was more obvious on the side opposite the degenerated pyramidal tract. The sections were cut to include the roots, and sections at one level would show far more degenerated fibres in the roots than at another level. The degenerated roots would be sometimes more apparent on one side than the other. Lissauer's tract generally showed diminution of fibres, but it varied at different levels. In the lumbo-sacral region, sections showed atrophy and denudation of fibres throughout the posterior column, except in the oval area of Flechsig and the cornu commissural zone. As in the dorsal region so here, the atrophy and sclerosis of roots is the subject of considerable variation, and is nowhere complete.

Spinal ganglia (stained by the Weigert method) cut in series. The cells show in great part some protoplasmic change, for they have a blue appearance owing to the presence of fine stained granules. The nerve-fibres leaving the ganglion show considerable atrophy and sclerosis. In the capsule of the gland, and in the distal roots, a number of bundles of fine medullated nerve-fibres are seen, which are either deficient in fibres or are unstainable. The third lumbar was stained by the Nissl method (serial sections of this ganglion being made). All the sections showed a variable number of cells presenting changes varying from slight chromatolysis to a very marked condition of the same. In many of the cells the nuclei are eccentric and hardly stained at all.

Vascular and meningeal changes. The changes in the meninges are not extensive, and although they are somewhat thicker over the posterior column of the cord, still there is not a marked flattening as is found usually in a prolonged chronic case. Nowhere could a process of endarteritis be seen, and the thickening of the vessels would in no way explain the atrophy of the fibres. The sections of the cauda equina show that the vessels in the undegenerated anterior roots were as often thickened as those in the posterior, and in no case was an artery found blocked. Congested veins were found equally in both degenerated and undegenerated roots.

The retinae and optic nerves were cut in celloidin and stained by logwood and eosin, by the Ströbe and Weigert methods.

The retinae exhibited no inflammatory changes or alteration of the vessels. The ganglion cell and nerve-fibre layers were entirely absent. The rods and cones were not distinguishable, but there was undifferentiated protoplasm, stained with the logwood, lying between the hexagonal pigment cells and the granular layers, which are intact. The sustentacular fibres of Müller were very distinctly seen owing to the absence of the ganglionic layer. There was considerable excavation of the papilla.

The optic nerves were shrunken to half the normal size. The nerve-fibres were absent, their place being occupied by a fine meshwork containing a large number of round and oval granular nuclei or cells. The interstitial septa are thicker and more obvious than usual, and contain also a number of proliferating cells or nuclei. The vessels show no apparent change or only slight thickening of their walls.

Occasionally one member of a family suffers from tabes and another from general paralysis, e.g. of my 120 cases of tabes and tabo-paralysis there were the following examples: (1) two brothers in two instances; (2) brother and sister in one instance; (3) father, general paralytic, with child, congenital syphilis and tabes with optic atrophy. Cases such as these indicate an hereditary soil or temperament suitable for the virus to act in producing the degenerative process.

Juvenile tabes dorsalis. Remak has described three cases of tabes in children; in two there was certain hereditary syphilis, and in one probable, the father of the third likewise had tabes. Goldflamm has described a case of acquired syphilis that developed tabes and also had several children who suffered from this disease.

Strumpell described tabo-paralysis in a 13-year old girl with hereditary syphilis. Both Gowers' two cases had hereditary syphilis, likewise Mendel's two cases. Fournier has described four cases with certain syphilis in one and probable in the others. Bloc and Gilles de la Tourette each reported one case with certain syphilis, and Erb three pairs of sisters, six cases in all, in whom hereditary syphilis was demonstrable. Gowers, Fournier, Raymond, Homen, and others have described cases of tabes in adults as the result of hereditary syphilis. Williamson described three cases; all three patients were blind, owing to primary optic atrophy. In two cases there was evidence of congenital syphilis, and in the third congenital syphilis was probable; in one case the father was a tabetic. Babinski recorded two cases of hereditary syphilitic tabes, one that of a young woman aged 22, the other that of a girl aged 15. Both patients presented signs of hereditary syphilis, and the fathers in both cases suffered from tabes. In the discussion on these cases Souques referred to a family of four persons (parents and two daughters); the father died of general paralysis, the mother suffered from tabes, and both the daughters suffered from tabes. 'Laisser has collected 21 cases of juvenile tabes recorded in medical literature. In 17 there was a clear history of syphilis in the parents; in 2 this history was probable, and in 2 doubtful. Optic atrophy was a common symptom, but ataxia was absent in two-thirds of the cases' (Williamson). Erb has referred to most of the cases on record up to 1904. The cases of tabes occurring in heredo-syphilis are not nearly so numerous as the cases of general paralysis; the ataxy is usually not very marked, optic atrophy is very common, and tabo-paralysis is met with, often associated with optic atrophy; optic atrophy occurs also pretty frequently in the paralytic dementia of congenital syphilis. I have seen two brothers so affected who died after developing the signs of progressive dementia.

The period of time elapsing between the evolution of tabes and general paralysis and the acquired affection varies considerably; it may be from 3 to 31 years, but the average is 8 to 15 years. I have seen one case in which general paralysis came on three years after infection. Ehlers and Fournier have both recorded cases. According to Fournier general paralysis is absolutely unknown during the first two years after infection, and only begins to appear in the third. The most usual date for its development is comprised between the sixth and twelfth years. The life of the neurones has been reduced and the time that will elapse between infection and the onset of decay depends upon the intensity of the virus and the inborn resistance of the nervous system, together with other supplemental factors causing stress. In these hereditary cases it is surprising how frequently we find one of the parents and occasionally both suffering from paralysis or tabes ; this implies an inborn tendency to this degenerative condition. Now, it may be asked, if twenty-five years or even more can elapse in an adult between the acquirement of syphilis and the onset of the symptoms of parasyphilis, why should not the same long period occur occasionally in congenital syphilitic cases, or that instead of the first symptoms commencing at puberty they are not manifest till adolescence or even considerably later. Nonne relates a case of a workman, aged 32, who had suffered for two years with lightning pains and had never been infected with syphilis or addicted to drink, and who presented all the typical signs of ataxy. He had been treated in the hospital for severe hereditary syphilis. I have occasionally observed similar cases of general paralysis, e.g. a man, aged 28, died recently in one of the London County Asylums of very advanced general paralysis. The disease was first manifested at the age of 18, when he had a fit. His character was strange ; he married, had one child born dead, afterwards his wife left him. He had no signs of syphilis on his body, but I found that his father had died eight years previously in Claybury Asylum. In my Croonian Lectures upon the Degeneration of the Neurone, I remarked that it is very probable that some of the cases occurring in adults, in which syphilis can with certainty be excluded, may still owe the disease to an inherited syphilitic taint. It is not even necessary, as quite one-half of the juvenile cases show, that they should exhibit any external signs of congenital syphilis, for many of the juvenile cases which I collected were proved beyond doubt to be born of syphilitic parents, although manifesting themselves no external signs of syphilis, whereas brothers and sisters exhibited very definite signs. A case of general paralysis died at Banstead Asylum which had previously been under the care of Dr. Percy Smith at Bethlehem Hospital. This woman had characteristic signs of congenital syphilis, but she did not manifest symptoms of progressive dementia till she was 30 years of age. The patient was an unmarried woman, and there was no reason to believe that she had acquired the disease. Recently Christian Muller has put forward the same hypothesis to explain those cases in which no history of acquired syphilis can be obtained. He describes two cases of women (virgins) who were the subjects of well-marked signs of congenital syphilis, and who died of general paralysis at the ages of 42 and 43 years. The symptoms were not noticeable till a year or two before death.

In looking over the post-mortem notes of cases that have died at Claybury Asylum during the past ten years, I have been struck by the fact that whereas in syphilitic brain disease it is the rule to find evidence of tertiary skin lesions, in general paralysis it is quite the exception. A considerable number of cases of general paralysis show the scar of a chancre, and indurated inguinal glands ; and it is not rare to find the scar of a bubo, but it is very rare indeed to find visceral gummata in general paralysis. Occasionally an aneurysm exists, but not nearly so often relatively to the numbers as in syphilitic brain disease. It is common in the subjects of general paralysis to find pearly fibrosis of the aorta in the nodular and plaque form, also atheroma and even calcareous plaques. In quite 80 per cent. there is some arterial sclerotic change of the aorta ; as a rule the degree depends upon the age at death, but I have observed it fairly well marked in quite young paralytics, and once or twice even in the juvenile cases. Westenhofer examined the bodies of seventy-two cases of tabes at Virchow's Institute ; in 44 per cent. certain or doubtful signs of syphilis were obtained. These results compare very closely with those I have obtained in general paralytics.

Racial syphilis in uncivilized countries in relation to tabes and general paralysis. It is asserted that in countries where syphilis is extremely common—Bosnia, Herzegovina, Algeria, Abyssinia, and Japan, tabes and general paralysis are extremely uncommon or never met with. Egypt was cited formerly, but the statistics of Dr. Warnock, of the Abassich Asylum, Cairo, show that 6 per cent. of the inmates are general paralytics, and he states that syphilis is demonstrable in the majority of these cases; moreover, he considers it the essential cause of the disease. More accurate investigations have shown that tabes and general paralysis are common in Japan (Nose); tabes is not unknown in Bosnia and Herzegovina; according to von Halban, tabes is more common in Abyssinia than it is in Vienna, and it certainly occurs among negroes, as I have seen cases in this country and in Jamaica. Parasyphilis is not so common among primitive races as the more civilized, but this is not the point. The essential fact is that tabes and general paralysis only occur where infection with syphilis is possible. 'If tabes can be shown to exist, or to have existed in any land or people among whom syphilis has never entered, and who have never had communication with any outside syphilized world, the exclusively syphilitic origin of tabes will have to be abandoned, but not till then' (Ferrier).

The comparative rareness of these diseases in quakers and priests supports the syphilitic doctrine. I have seen general paralysis in two priests, and in both there was a history of syphilitic infection. We can only reconcile the statement that races exist that are extensively syphilized but do not proportionally suffer from general paralysis and tabes, by presuming that other contributory factors are absent, viz. an inherited inborn neuropathic or psychopathic tendency, associated with exciting factors involving mental stress and the using up of nervous energy.

THE INTERVAL OF TIME ELAPSING BETWEEN SYPHILITIC INFECTION AND THE ONSET OF SYMPTOMS OF TABES AND GENERAL PARALYSIS.

Cerebral or spinal syphilis may occur at any age; that is to say, at any period after infection, but the majority of cases occur in young adults before the commencement of the fourth decade; in fact, a very large number suffer before the age of 25, thus contrasting markedly with tabes dorsalis and general paralysis.

The close similarity in the time interval between infection and onset of symptoms in tabes dorsalis and general paralysis, coupled with the facts shown in the subjoined table regarding the similarity of the decades at which the onset of symptoms occurred in these diseases, affords strong support to the view that, although clinically different, they are nevertheless pathogenetically the same.

In sixty-five cases of tabes, the average age of onset was 37. The average interval between a definite history of infection and onset of symptoms was ascertainable in more than half the cases, and was fifteen years. The shortest period was four years. Erb found that the great majority of cases occur within twenty years of infection, with a maximum between six and fifteen years.

In 100 cases of male paralytics, taking the date of certification as the date of onset of symptoms, the average age was 40. Probably the date of certification is really several years after the onset of symptoms in quite a number of cases.

The onset of symptoms in tabes dorsalis can be more definitely fixed by subjective symptoms and objective signs than in general paralysis; moreover, the tabetic patient is able himself to fix the date when he first noticed symptoms. Thus in 60 per cent., lightning pains were the first symptom; in 12 per cent., double vision; in 14 per cent., visceral troubles, e.g. bladder disturbances or gastric crises; in 10 per cent., arthropathies or spontaneous fractures; in 10 per cent., failure of vision and blindness, &c. The onset of mental symptoms observed by the friends is more difficult to decide; consequently the age incidence of the onset of paralysis really dates from the time when he becomes anti-social, therefore the average age, 40, is a little higher than tabes dorsalis, 37.

The subjoined table giving the decades at which the onset of symptoms occurred in tabes dorsalis and general paralysis, is instructive; it shows that about 80 per cent. of the cases occur in the fourth and fifth decades. This may be accounted for by the fact that the majority of people who acquire syphilis are infected in adolescence or early manhood; if we add 10–20 years as the latent period, we can understand why the great bulk of the cases of tabes and general paralysis occur at the prime of life or soon after.

Decades at which the onset of symptoms occurred.

	Tabes dorsalis.	*Female general paralytics,* 118 *cases.*	*Male general paralytics,* 100 *cases.*	*Tabo-paralysis.*
1st decade . .	1·5 per cent.			
2nd decade . .	1·5 ,, ,,	1·75 per cent.	1 per cent.	6 per cent.
3rd decade . .	8·5 ,, ,,	1·75 ,, ,,	8 ,, ,,	4 ,, ,,
4th decade . .	47·1 ,, ,,	47·45 ,, ,,	44 ,, ,,	72 ,, ,,
5th decade . .	32·3 ,, ,,	39· ,, ,,	38 ,, ,,	20 ,, ,,
6th decade and over	13·3 ,, ,,	8·5 ,, ,,	9 ,, ,,	6 ,, ,,

Tabes and General Paralysis in old people. In the above table it will be observed that over 13 per cent. of cases of tabes dorsalis commence in the sixth decade, and about 9 per cent. of paralytic cases. Tabes dorsalis is relatively much more frequently met with in old people than general paralysis, the reason of course being that the latter disease is usually fatal in a few years, whereas the former disease does not greatly interfere with length of life. Old people suffering with tabes belong to two categories: (1) the more numerous being those in whom symptoms commenced in the third and fourth decades, and who have survived twenty or thirty years after the onset of symptoms; (2) the less numerous being those in whom symptoms commenced in advanced life or even old age, and there is not a great disparity in the percentages of tabes and paralysis, as the above table shows.

Pitres, in a paper on senile tabes founded upon 350 personal observations, found that 9 per cent. commenced after 50 years of age; 26 cases being between 51 and 60 years, 5 between 61 and 70, and 1 after 70 years. Of the 9 per cent. male cases of general paralysis occurring after 50, 3 were over 60, one being 65. It may be observed that in this 100 cases of general paralysis, the diagnosis was confirmed by post-mortem examination in every case.

When tabes commences in advanced life or old age very long after infection, it is spoken of as *tabes tardif.* Erb mentions a case which occurred 25–35 years after the chancre. Dieulafoy has recorded a case arising 35 years after, and Chiray and Cornelius have published a case of Dejerine's, in which tabes occurred 50 years after infection. Raymond has also recorded a case which occurred 45 years after infection.

Hereditary predisposition. I do not think hereditary predisposition plays such an important part in tabes as in general paralysis. Charcot, Ballet, Benedikt, and Borgherini consider it an important factor in the production of tabes. It is probable that a neuropathic inheritance and that temperament which would easily develop neurasthenia are predisposing causes of great importance. Redlich attaches no great importance to heredity, but Rosenblatt, Raymond, Fournier, Erb, and Gowers look upon it as a factor of considerable importance (Redlich). Among the tabo-paralytics and tabetic insane, I found a history of insanity or epilepsy in about 30 per cent. Among general paralytics there is about the same percentage; this, however, does not really represent the actual percentage, but rather that which was discoverable. Dr. Wiglesworth has pointed out that hereditary influence plays a less important part in general paralysis than in other forms of insanity. I have found in about 30 per cent. of the cases of general paralysis a family history of insanity, epilepsy, or drunkenness; probably this is less than the actual percentage, but epilepsy, recurrent periodic insanity (manial depressive insanity) and the insanity of adolescence (dementia praecox), according to my observations, have a much higher percentage. I have collected all the cases of insane relatives in the London County Asylums, and I have been struck with the frequency with which the above types of insanity occur, and the relative infrequency of general paralysis. Still, if great personal trouble be taken to obtain a family history in cases of general paralysis, it is astonishing how large a proportion of paralytics have a family history conducive to degeneration; actual insanity, epilepsy, pyschoses or neuroses, intemperance, and eccentricity are found usually in one or more members of the family.

Recent researches of Junius and Arndt prove that hereditary taint in general paralysis is much more common than is usually admitted. They obtained a history in over 30 per cent., and state that that is too low. But statistics relating to the degree of importance of heredity in the production of diseases, bodily or mental, require a more scientific method of inquiry than has happened in asylums in the past. To be of scientific value, a series of family histories of normal and insane persons based upon a uniform plan of inquiry, and without the desire to prove anything, must be collected and placed in the hands of a skilled biometrician for analysis and computation. I have little doubt that we should find *hereditary nervous instability* in one or more of its many forms present in ascendants and still more in the descendants in a large number of the general paralytics. By nervous instability I include the imaginative and eccentric person, even genius, who is clever, excitable, and with a quick mental reaction, but who lacks the highest control, calm judgement, and moral tone of a well-balanced mind.

Intemperance. A history of excesses in *baccho et venere* is a common result of inquiry as to the past personal history of patients suffering with general paralysis and tabes. 'Lived a fast life,' the wife or friends tell you. A number of cases in which intemperance is assumed to be the cause of the mental breakdown are really cases in which the man gives way to drink on account of the onset of the mental disease, in fact, this may be the first sign. It is not normal to find post mortem in the organs (liver) of cases of general paralysis evidence of prolonged abuse of alcohol. Alcohol undoubtedly acts as an exciting cause, but by itself it cannot produce either tabes dorsalis or general paralysis. Lust and intemperance are frequently the first manifestations of the degenerative process affecting the brain or the cord. In the rural districts of Ireland, where alcoholism is extremely common, together with insanity and imbecility, general paralysis is hardly ever seen. These last two factors, hereditary taint and alcoholism, apparently then by themselves and without syphilis, which is rare in the rural districts of Ireland, cannot produce general paralysis.

Trauma. Klemperer collected from various sources of literature thirty cases of so-called traumatic tabes; but Hitzig, in a valuable monograph on the subject, dispossessed Klemperer's inferences of much of their import. Hitzig showed that very few of Klemperer's collected cases could be considered as genuine traumatic tabes. Erb gives the percentage as 0·3, Leyden and Goldscheider say that it is not an important cause; it may occasionally act as a contributory factor. Most authorities, however, agree that head injury may be an exciting factor in quite a fair percentage of cases of general paralysis. I should think 10 per cent. of the cases admitted to the asylums have a history of head injury; but it is probable that in many of these the disease had started before the injury; thus the patient may have fallen from a ladder or a building in an apoplectic fit or epileptic seizure. If a patient, suffering with undiscovered general paralysis, receives a blow on the head in a quarrel, the head injury (indirectly) is the result of the disease, not the cause; that it will lead to its more rapid progress there is little doubt, especially if the injury be associated with commotion or concussion. The following case illustrates this point.

Case 38. P. E., a baker, aged 34, was admitted to Claybury Asylum suffering with general paralysis on Sept. 3, 1897. He was in a street-row on August 23, and *is said* to have received a blow on the head which rendered him unconscious. The next day he was strangely excited; he left his work and made the acquaintance of some girl, whom he drove about in cabs, sending the cabmen home to be paid. He threatened to take out a summons against his assailants of the previous night and bought a revolver, with the declared intention of shooting somebody. When admitted to Claybury he was in a state of acute expansive grandiose delirium, shouting and dancing. He states that he can earn £300 a week, is a wonderful genius, a music-hall artist, a patent baker. He is intensely erotic and is to marry the beautiful girl. Pupils irregular, unequal, sluggish reaction to light, tremor of face and tongue and slurred speech. He had a number of epileptic, congestive, and apoplectic seizures, and died within three months of admission.

It is, however, probable that head injury may be a determining factor in the production of the disease in a certain number of cases of persons who have suffered with syphilis. It is well known that traumatic neurasthenia may arise, and that persons who have suffered head injuries are intolerant of alcohol. They may have, in fact, an invalid brain. It therefore becomes a matter of very considerable importance in connexion with the liability of employees to decide how far an injury to the head may be the cause of general paralysis. The following case came under my observation and illustrates this point. A patient at one of the London County Asylums died of general paralysis; his wife claimed damages from the railway company in whose service her husband had been many years a guard. It appeared that the man himself had not felt fit for his work and stated that in shunting the train he had received an injury to his head; it was possible that he had had a seizure and fallen down. He was seen by the medical officer of the company, who gave it as his opinion that there was nothing organically wrong with him and that he was fit for work. In the early stages of general paralysis it may be very difficult from a single examination and without seeing the friends to detect any mental disease; yet subsequent inquiries from fellow officials showed that for some time before the accident, this man had been strange in his manner and not like himself. But in such a case it would be difficult for the railway company to deny responsibility, in view of the expressed opinion of their own medical adviser. I was asked, in reference to this case, whether head injuries could be considered a cause of general paralysis, and I gave it as my opinion that in a certain number of cases in which head injury had occurred it might be assumed that, had there been no head injury, paralytic dementia would not have ensued.

Lead-poisoning. Naturally a considerable number of general paralytics are men engaged in occupations in which chronic lead-poisoning may occur; but I do not find that these occupations are especially associated with the disease. Again, only relatively a few of those persons who are engaged in working with lead in consequence suffer from chronic lead-poisoning. There is no doubt that lead-poisoning will produce arterio-sclerosis, renal inadequacy, uraemic symptoms, and a chronic lead encephalitis, and this whole group when combined with chronic alcoholism, gives a clinical picture in many respects like general paralysis, but an examination of the brain shows that it is not the same disease. Still it is probable that chronic lead-poisoning may, by its devitalizing influence, become an important coefficient in the production of general paralysis when combined with the effects of syphilis.

Stress. Edinger has emphasized the importance of stress in determining the seat of the degenerative process, and he has shown by experiment that degenerative changes in the posterior columns of the spinal cord can be induced in animals rendered anaemic by a poison like pyridin, if these animals are daily made to use their limbs for a certain time so as to produce artificial stress of the nervous structures concerned in locomotion. My experience certainly shows some instances in which occupation has apparently determined the seat of the lesion. The occupation of sixty successive male cases of tabes dorsalis met with in hospital practice or outside the asylum, showed only two that were not laborious, involving stress of the lower limbs. These were two clerks, and one of them suffered with cervical tabes, and in the other the arms were early affected and the patient subsequently became a tabo-paralytic case. Policemen are frequently affected, and in one case of ataxy in a policeman I remarked to the students that it was unusual to commence in the arms as it did in this case ; the man immediately volunteered the remark that he had been a mounted policeman ; and the arm first affected was the one with which he held the reins. Two packing-case makers, a carpet planner, and a parcel post sorter were early and markedly affected in the arms. Two tailors were only affected in the legs, but they worked a treadle sewing-machine. A carpet planner who knelt all day suffered with tabo-arthropathy of both knee-joints, whereas a stonemason, who wielded a 4-lb hammer in his right hand and a chisel in the left, suffered with a Charcot's joint of the right shoulder and arthritis of both hands and of the left elbow (vide Fig. 20, p. 243).

Mental stress and worry. In many cases of paralysis I have learnt from the friends or wife that the man had worried over his business, or had speculated and lost his fortune. Shock from death or illness of a near relative, wife, or child, may have occurred, and not infrequently loss of sight from optic atrophy has been followed by paralytic dementia. The degree of mental distress cannot be gauged by its outward manifestations. Grief and worry and constant apprehension for the future produce more mental depression when the emotions are suppressed, and frequently even the nearest relative may not have known what a mental conflict has taken place in the suppression of the outward manifestations of the inner working of the mind. The following case illustrates the effect of severe mental shock. Case 39, R. E., aged 35, married, newspaper reporter, was admitted to Claybury. 'He was a clever, industrious man, and for eight years had been parliamentary reporter for one of the leading London daily papers. He contracted syphilis at 30, married at 31. His wife had three children, no miscarriages. Early in 1896 all his children died, and in March of the same year he became very depressed and would sit for hours brooding over his troubles, refusing to answer the questions of his friends, or only answering in monosyllables. A tremor of his hand, thought to be writer's cramp, was then noticed; his speech became slow and hesitant, and his intellectual faculties notably impaired; but he showed no evidence of moral obliquity nor did he exhibit any sign of exaltation. Later he

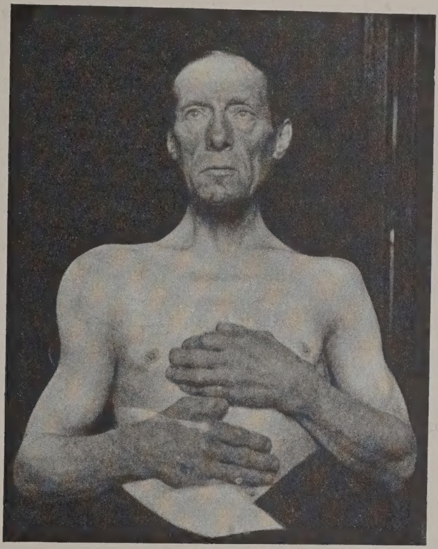


FIG. 20. A case of Charcot's joint, right shoulder, the only other sign of tabes being the Argyll-Robertson pupil. This patient remained in the pre-ataxic stage fifteen years.

became irrational and developed grandiose delusions, and he was brought to Claybury Asylum, Oct. 24, 1896. The delusions of grandeur persisted even when he became quite demented. There are a number of contributory factors in this case, viz. marriage soon after contracting syphilis, the worry at the loss of his children, which he probably believed was due to the syphilis he had contracted, and his work, which was associated with responsibility and stress.

All those conditions, which would lead to cerebral congestion or exhaustion, may act as important determining factors in the production of the onset of general paralysis. In many instances, gambling, speculating, intemperance, and sexual excitement with insomnia, combine in producing a condition of cerebrasthenia, or a congestive stasis ending in a fit. It is often difficult to decide whether these habits of the individual are premonitory and due to the onset of the brain disease or not. The history, on the one hand, of a change in the patient's character to such bad habits forebodes ill and indicates the onset of the disease; on the other hand, an inborn unstable temperament which is manifested later by a loose life is the most suitable soil to produce general paralysis and tabes dorsalis.

Sexual stress. Sexual excess is an undoubted causal factor in the production of both these diseases. The great majority of both tabic and paralytic men are married, and it is not an uncommon thing to find a man develop one of these diseases within a few years of marriage, and it is certain that sexual excitement hastens the progress of the disease. Dr. Savage, whose very large experience makes this statement especially worthy of consideration, says: ‘There are patients admitted yearly to Bethlehem whose diseases I believe to be chiefly produced by sexual excess; but such men are generally not only living lives of general excitement, but are wedded to women of a specially amatory nature; and although it would be unscientific to connote excess as necessarily associated with certain types of women, I have been struck by the frequency of the occurrence of general paralysis in the husbands of women of voluptuous nature.’

Sexual excess may have something to do with the production of general paralysis, but it must be remembered that a *hyperaesthesia sexualis* is often one of the early symptoms of both general paralysis and tabes—a symptom that is not infrequently followed by impotence.

Exposure to wet and cold. Exposure to wet and cold were often assigned as causes of tabes dorsalis. According to Erb, in only 1·4 per cent. of cases may exposure to cold and wet be considered as primary causes. Men working at forges, engine drivers and stokers, whose bodies are exposed to very unequal temperatures as well as to wet, may suffer in consequence, but as a rule exposure to wet and cold is only a contributory factor of not much importance.

It will be observed that all the evidence of the etiology of tabes and general paralysis tends to prove that there is in all probability one essential cause, syphilis acquired or congenital, and that there are a number of coefficients, any one of which by itself or in combination with others is not capable of producing the disease. The fact that congenital syphilis leads both to tabes and general paralysis at so early a period of life as to exclude most of the contributory factors except neuropathic heredity, is an argument in favour of syphilis being the essential cause. Moreover, since the sexes are equally affected with congenital syphilis, so males and females are affected in equal numbers with juvenile paralysis or tabes. In conclusion I cannot do better than quote Ferrier, who says: ‘One might multiply arguments in favour of the causal relation between syphilis and tabes, but they are unnecessary. For those above related, singly and collectively, leave, in my opinion, little room for doubt that tabes and general paralysis are in all cases of syphilitic origin, and that tabes *per se* is as much a proof of antecedent syphilis as a gumma of the skin.’

Although syphilis is the essential cause, yet, as Fournier showed, these diseases are not syphilitic, but an outcome of syphilis, and the riddle is still unsolved why only about 3 to 5 per cent. of the persons infected with syphilis should subsequently suffer with one of these degenerations of the nervous system termed parasyphilitic. But only 15 per cent. of persons suffering with diphtheria develop post-diphtheritic paralysis; these are usually cases in which the local infective process was mild and often unnoticed; in that respect, therefore, like parasyphilitic affections which more often than not follow mild and even unrecognized primary infection and secondary symptoms. Is it because the virus is attenuated or modified, and thereby has acquired a special neurotoxic action, or is it because in a small percentage of individuals the cells of the body, *especially the cells of the nervous system*, react to the virus in a hypersensitive manner? As already indicated there are facts which suggest the possibility of a certain form of virus with a neurotoxic action. Thus Babinski remarks that it seems possible that a syphilitic virus may sometimes be endowed with a particular aptitude for attacking the nervous system; he reports the case of two students who were infected the same day by the same woman; both died fifteen years later of general paralysis; these students were, however, related. I have recently heard of two professional men, not related, who acquired syphilis about the same time from the same nurse; ten years later they developed general paralysis. Marie and Bernhard relate the instance of two men who were infected from the same source, and ten years later suffered with tabes. Erb narrates an instance of four patients infected by the same woman, who later became the subjects of either tabes or general paralysis, whilst a fifth, who had connexion with the woman but was not infected, did not suffer from any disease later. I am indebted to my friend Dr. George Gibson for calling my attention to the following striking example given by Morell-Lavallée :

Marthe X.

May, 1870 Mistress of *Primus* (?) (Medical Student), and gave him syphilis. He died 1873 of *Syphilitic Meningitis*.	December, 1871 Mistress of *Secundus* (Medical Student), to whom she gave syphilis. He married later, had two healthy children, and died, 1888, of *General Paralysis*.	January, 1872 lived four years with *Tertius* (Medical Student). He married later, had two healthy children, and died, 1882, of *General Paralysis*.	later mistress of *Quartus* (Chemist). He died, 1890, of *General Paralysis*.	still later mistress of *Quintus* (Engineer), He died (no date) of *Folie syphilitique*.

Probably the most striking example supporting this theory of a special neurotoxic virus has been afforded by Brosius, who relates that seven glass blowers suffered with chancre of the lip, and out of five who ten years later came under observation, four suffered with either tabes or general paralysis. If we accept the fact that a spirochaete is the specific causal agent of syphilis, it is conceivable that there may be varieties of this organism as there are of the malarial parasite or trypanosome. Again, the organism may become modified in its passage through the bodies of certain individuals, or it may be modified by the action of mercury. It may thus happen that the virus may vary in different cases of infection. This, however, is speculation, and not only is not supported but also is rather contraindicated so far by experiments on animals. For, although lower apes have the disease in a mild form when inoculated from the human being, yet the syphilitic virus of an infected Macacus Rhesus, when used to infect a chimpanzee, appears to have lost none of its original virulence, for the chimpanzee suffers as badly as if it had been infected direct from the human source of the virus. We are probably therefore on more certain grounds in attributing the variations of the effects which will follow infection not to the variation of the virus but to the reaction of the individual himself ; and we may represent this in the form of an equation.

$$\text{Symptom complex } x = \frac{V}{R} = \frac{\text{virus}}{\text{resistance.}}$$

If the virus V is constant, R resistance must vary. But R is made up of a number of factors, some of which we can ascertain, but it is generally impossible to decompose R into all its constituents. Roughly speaking, we may say that it is made up of what a man is born with, what has happened after birth, and what will happen in the future to resist the action of the specific virus, which in the majority of instances is of lifelong duration. Most authorities agree that with the widespread syphilization of a race for many generations, the disease tends to assume a milder form ; the effects of the disease are not so severe, and a widespread tendency to an inherited immunity has been brought about. The conversion of a rural into an urban population has done much towards racial syphilization and to the diffusion of a tendency to inherited immunity and the begetting thus of a mild form of the disease. But whereas there are fewer cases of severe syphilis than formerly, there are more cases of tabes and general paralysis. The interesting description given (*System of Syphilis*, vol. ii, pp. 339–355) by Col. Lambkin of the syphilization of the natives of Uganda, shows how severely a race previously free from this disease suffers from malignant skin, bone, and visceral disease. He also points out that parasyphilitic affections are rare, the reason being that the disease has not existed in the country for a sufficiently long time to allow of their frequent occurrence. If we consider some facts concerning congenital syphilis we must come to the conclusion that immunity is possible; how otherwise can we explain the law of Profeta, viz. the non-syphilitic child of a syphilitic mother does not acquire syphilis from the syphilized mother who suckles it. Again, the child may be syphilitic and the mother show no signs of syphilis, nevertheless the mother does not acquire syphilis by suckling that syphilitic child, whereas a wet nurse does. In the former case the foetus has acquired some antitoxin or something from the maternal blood which has stimulated its own tissues to react against the virus; in the latter (Colles's Law) the mother has derived from the blood of the syphilized child an antitoxin or something (not the living contagium) which has stimulated her tissues to react against the virus so effectively that she cannot be infected. There is no reason to suppose that the germ cells do not participate in this reaction, seeing that every cell in the body is subjected to the sensitizing influence of the chemical products of the virus by means of the blood and lymph.

The experiments of Ehrlich have been quoted by Neisser as opposing the view of inherited immunity; on the other hand Conradi's recent experiments support it. The histories I obtained in a large number of cases of juvenile general paralysis and cases of congenital syphilitic nervous disease revealed the fact that the mother very frequently had miscarriages, abortions, and typically syphilitic children without herself suffering at all, or presenting any signs of syphilis. In two instances the mother died of general paralysis ; in a considerable number of instances the father died of this disease. As a general rule the history obtained from the parents of juvenile paralytics is as follows : miscarriages, abortions, dead children, children dying in infancy, often of meningitis or hydrocephalus, children who later in life suffered with nervous affections, e.g. nerve deafness, paralytic dementia, optic atrophy, and tabes ; and finally, healthy children, and such a chain of circumstances would undoubtedly indicate that either the virus was becoming attenuated or the resistance to its action had been increased. In any case we may suppose that the children who were born with a syphilitic rash would be immune to reinfection, also those who afterwards suffered with parasyphilis; Krafft-Ebing's observations support this premiss. It is probably a question of degree of immunity to reinfection that would obtain in the presumably healthy children that followed the diseased ones. But this chain of events does not always occur, for sometimes children may be born with signs of heredo-syphilis after the birth of several healthy children, also parasyphilitic children may be born after the birth of several healthy children. This may be explained by the fact that the specific virus has become active again in the mother, which inference is negatived in most instances by the fact that she herself may say that she has been in good health and no signs of the disease can be discovered in her. Another explanation offers itself, and that is the specific virus may have attacked one ovum and spared another. Levaditi has seen the spirochaete within an ovum. No two individuals, even of the same family, are born alike, because the germ plasm out of which they were formed may be similar, but is not the same ; one inherits certain ancestral tendencies which the other does not ; and it may happen, therefore, that a child born later than the healthy children possesses less inborn resistance to the action of the virus, and consequently manifests congenital syphilis, or later parasyphilis. How can we explain this process of decay of particular groups, systems, and communities of neurones ? Why should we have optic atrophy in one individual, atrophy of the spinal portion of the sensory protoneurones in another, decay and atrophy of the cortical neurones in a third, and in many instances a decay and atrophy of the whole nervous system. We cannot suppose that it is caused by the random metastasis of the syphilitic organism in the membranes, or coats of the blood-vessels, conveyed by the lymph or blood stream, as is probably the case in the true syphilitic lesions of the brain and spinal cord. Everything points against this, for although parasyphilitic affections present the most varied signs and symptoms, there is one sign usually present which is for all practical purposes only met with in parasyphilis, viz. the Argyll-Robertson pupil. No coarse random lesion will explain the constancy of this phenomenon; moreover, this condition, although a sign of syphilitic infection, does not occur in true syphilitic brain disease. Spirochaetes have never been found in the cerebro-spinal fluid nor antigens. Antibodies are found in abundance and probably proportional to the extent of neuronic decay in tabes and general paralysis. I think all the facts are against the views of Lesser, Bosc, Hirschl, and others, that these late manifestations of degeneration of the nervous system may be regarded as quaternary syphilis, a very late effect of the virus comparable with syphilitic orchitis, glossitis, and other sclerosing lesions. According to this view we should be compelled to consider the meningeal and perivascular infiltrations and the glia cell proliferation as the cause of the degeneration. But there are many reasons why we cannot accept this hypothesis. The view I take of the process is that parasyphilitic disease of the nervous system depends upon two factors: intrinsic—innate, and extrinsic—acquired, the soil and the seed; the vital resistance and the specificity of the virus, $\frac{V}{R}$. All those conditions which may be inherited or acquired, and which tend to active metabolism of systems, communities and groups of neurones functionally correlated, and which, owing to those conditions of stress which in one individual would cause spinal neurasthenia, in another cerebral neurasthenia, will, in conjunction with the stimulating effect of the syphilitic poison, cause the nerve cells to exercise an abnormal metabolic activity in the production of the side-chain molecules necessary for immunization against the toxic effects of the virus.

Ehrlich points out that we cannot suppose that the cells of the body possess *per se* an executive defensive capacity to neutralize the noxious effects of all forms of organisms, and his work on haemolysins shows that the haemolysin for the corpuscles of a particular animal only occurs after incorporation of the molecules of those corpuscles. But we may suppose that there is an *inherent* aptitude for the cells of the body of certain individuals to readily adapt themselves to defence against the action of the syphilitic virus in a race that has been widely syphilized for generations; consequently a larger number will have a mild form of the disease.

The nerve cells are perpetual elements incapable of regeneration, highly differentiated and complex in structure and function; their centre of nutrition is the nucleus, and when decay sets in, the retrogressive process attacks first the fine twigs and branches and rootlets of the tree, the dendrites and dendrons; in fact, the process is an inversion of its growth and development. But what should cause this premature decay and lack of durability? for the specific energy of the whole of the neurones in the healthy body is sufficient to last until the vital spark dies out. We know the prolonged duration of infectivity of the syphilitic virus as compared with other contagious diseases, also that one attack of syphilis confers immunity during the rest of the individual's life; moreover, the experiments of Krafft-Ebing are important to remember in this respect. The nerve elements being perpetual, and having acquired a habit of throwing off side-chain molecules, will continue to do so during life, and will contribute largely to the immunity produced. When there is no longer metabolic equilibrium, and decay sets in, these antibodies are thrown off in increasing numbers (vide pp. 211, 212); this seems probable from the fact that in general paralysis and tabes the quantities increase with the progress of the decay. The process of decay will manifest itself in the earliest stages by an increased irritability and functional activity of the nervous structures, often manifesting itself in a *hyperaesthesia sexualis,* and not infrequently in striking intellectual activity, followed in each case by exhaustion and loss of function.

To follow the argument further it is necessary to explain the meaning of the term lipoid substances. They are found in all animal and vegetable cells, and are probably as important for the vital activities of protoplasm as the proteins themselves. They consist of three groups (1) nitrogen and phosphorus free, viz. cholesterin, fatty acids, and lipochromes; (2) cerebrosides, bodies containing nitrogen but no phosphorus, phrenosin, and kerasin; (3) phosphatides (Lecithins) containing both phosphorus and nitrogen. It is probable that the cytase or complement which leads to haemolysis in the presence of the amboceptor acts by virtue of a ferment (lipolytic) action upon the lipoid substance of cells whereby they become unloosened and liberated into the blood (vide Chapter V, p. 200). It is possible that the abundant presence of these lipoids in the blood and cerebro-spinal fluid may account for the exaltation and excitement so characteristic of general paralysis. Again, it is possible that the toxic effects of bacterial poisons from secondary and terminal infections may be greatly increased by the presence of these lipoid substances.

The uselessness of antisyphilitic remedies is thus easily accounted for; indeed, they are generally positively injurious in true tabes and general paralysis, because they lower the vital energy in a system which is hypersensitive to the syphilitic virus. The only hope of doing any good is by an early diagnosis of the disease and suppression of all those exciting causes which use up the nervous energy and tend to overturn the normal metabolic equilibrium of the nervous structures. Other factors come in determining the location of the degeneration, and although microbial infections and microbial toxaemias are not directly responsible for these parasyphilitic affections, yet they may be an exciting agent to the onset of the disease, the aggravation of the symptoms, and the acceleration of the progress of neural decay.

I have often observed when influenza, dysentery, or pneumonia were prevalent in the asylums that a number of general paralytics died after a succession of epileptiform or apoplectiform seizures, and I have found post mortem that they were suffering from one of these morbid infections. It is a common thing to find on the post-mortem table patches of broncho-pneumonia the appearances of which would accord with clinical notes in the case-book reporting the occurrence of seizures; and if the brain be examined microscopically it is quite easy to prove that these fits correspond with acute degenerative changes, doubtless caused partially by congestive stasis and partially by a toxic condition of the blood exciting and accelerating the process of neural decay. Bacterial invasion *secondary or terminal* of the organs of the body of a *non-specific* nature therefore may accelerate the morbid process of decay or bring about a fatal termination; but there is no satisfactory evidence to show that there is any specific bacterium other than the *Spirochaete pallida*), and the evidence offered by Ford Robertson, in support of his hypothesis that there is a *Bacillus paralyticans longus* responsible for general paralysis and a *Bacillus paralyticans brevis* which causes tabes, is entirely inadequate and unconfirmed by other competent observers.

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CHAPTER VIII

GENERAL PARALYSIS OF THE INSANE

Syn. General paresis; Dementia paralytica. Fr. Paralysie générale. Ger. Allgemeine progressive Paralyse.

Definition. A fatal disease characterized by a progressive decay of the brain causing a corresponding progressive paresis and dementia, often associated with grandiose delusions; it occurs in the subjects of acquired or congenital syphilis, but is not influenced in its course by antisyphilitic remedies.

Historical. The discovery of general paralysis as a distinct disease is generally regarded as having been due to French observers in the early part of the last century; although there are good reasons for supposing that Haslam, the apothecary at Bethlehem Hospital, recognized the disease, for in his 'Observations on Madness and Melancholia', he gave a description of certain forms of paralytic insanity which were invariably fatal. Thus he says, 'The paralytic affections are a cause of madness much more frequently than one supposes and they are also a very common effect of mania. Paralytics usually present disturbances of locomotion, independent of their insanity; speech is embarrassed, the arms and legs are more or less deprived of voluntary movement. Sir Alexander Morison, in his 'Physiognomy of Mental Diseases, 1840', gives a very good clinical account of the disease, and remarks that Drs. Calmeil and Esquirol had given the disease the name of general paralysis of the insane, but 'by the regulations of Bethlehem Hospital cases of this description for *upwards of fifty years have been excluded*; nevertheless patients in the early stage of the disorder have been frequently admitted and have undergone treatment for a limited time; so it is well known there. When a patient is brought to the hospital expressing ideas of high rank or expectations, great abilities, extensive possessions or much wealth, particularly in articles of gold, with impaired memory and weak volition, or what may be termed infirmity of purpose, and at the same time has a slight difficulty or hesitation of speech and an unsteady or tottering gait in walking, it is concluded that he labours under this formidable disorder in its early stage and that there is little or no chance of his recovery'. Sir A. Morison, it may be observed, was attached to Bethlehem and must have been aware of Haslam's description. Long before Haslam had differentiated this form of paralytic insanity, the keen observation of Hogarth had depicted one of its most characteristic symptoms. A scene in Bedlam in 'The Rake's Progress,' 1735, exhibits two portraitures of elated insanity.

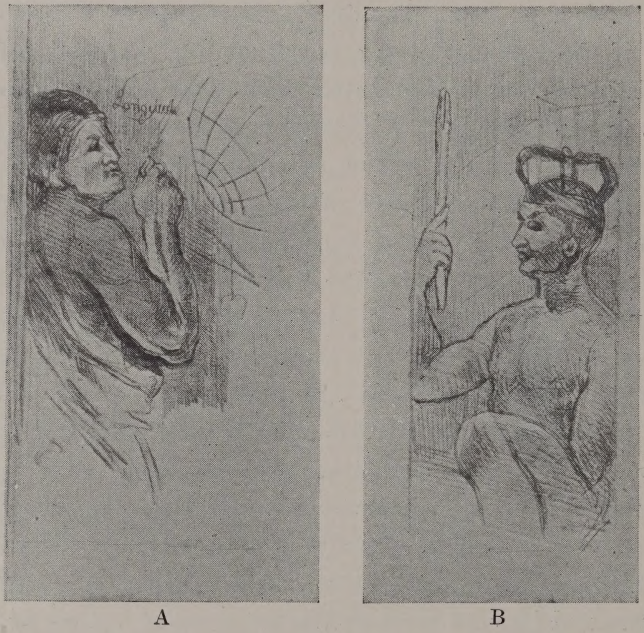


Fig. 21. Two portraits of Elated Insanity from Hogarth.

These two portraits are here reproduced from Morison's 'Physiognomy of Insanity' with the explanation (p. 279): 'Upon these portraits Gilpin observes, that the self-satisfaction and conviction of him who has discovered the longitude (Fig. 21 A) and the mock majesty of the monarch (Fig. 21 B) are admirable; the latter deems himself worthy of a crown, and sits in an attitude of great pomp, viewing his wooden sceptre and wearing his paper crown with as much conviction of his dignity as any monarch in Europe.

The mind of the other seems lost in thought; and Hogarth's peculiar genius appears in his having the geographer, 'whose element is ranging the wide world, here closely mewed up in a corner.'

An excellent account of the evolution of our knowledge of this disease in the French School, is given by Ballet and Paul Blocq, 'Traité de Médecine', vol. vi, who assert that Haslam was within an ace of discovering the disease. These authors state that in 1816 Esquirol had recognized that certain lunatics were afflicted with paralysis and speech troubles; but it was Bayle who really deserves the credit of having separated general paralysis from the confused groups of insanities. 'In his doctoral thesis, 1822, he showed that the disease is a perfectly autonomous entity and he attributed it to a chronic arachnitis. Later, in 1826, in his 'Traité des maladies du cerveau', he completed his description. The short and superficial work of Delaye added nothing to the observations of Bayle, and that of Calmeil marked a harmful return towards the views of Esquirol. But in his ultimate publications this master gave up his former erroneous views.

Parchappe and, according to him, Lasègue and J. Falret, supported the doctrine of Bayle, which since this period has not been contested.

Later, Baillarger, while admitting the reality of the disease of Bayle which constituted, according to him, *Dementia paralytica*, endeavoured to prove that there existed besides, a paralytic insanity distinct from general paralysis; there would thus be two varieties of general paralysis. The dualism of Baillarger, however, was no more legitimate than that of Esquirol.

The first or *clinical period* was followed by the *anatomical period* in the evolution of our knowledge of this disease. The names of Rokitansky, Magnan, Westphal, Mendel, Mickle, Zacher, together with many others, are associated with the anatomical investigation of the brain in this disease. 'At first considered as a chronic primary meningitis, general paralysis was for a time regarded as a secondary manifestation, dependent on vascular lesions, caused themselves by a primary alteration of the cervical sympathetic ganglia (Burnet and Poincaré).'

Later, when the lesions of the white substance and of the basal ganglia were found, there was a tendency to believe that these were primarily affected and caused secondary changes in the grey matter of the cortex. But soon there was a return to the view that the primary lesion was in the grey matter of the cortex itself, and the question arose as to whether it was, as Rokitansky originally stated, due to an *interstitial encephalitis*, or of parenchymatous origin. Mendel, Magnan, Meerzejewsky, Christian and Ritti, Mickle, Bevan Lewis, Wiglesworth, Ballet, and many others, ranged themselves on the side of those who advocated a primary interstitial inflammation with secondary degeneration of the nervous elements. For these authors, the chronic inflammatory changes as exhibited by the perivascular cell proliferation, the new vessels and the neuroglia proliferation preceded and caused the cell degeneration, and for some time this opinion prevailed. But with the advances in knowledge and the development of the neurone doctrine, opinion has changed round to the views first advanced by Tuczek, Schulze, Friedmann, Ziegler, Kronthal, Pierret, Joffroy, Binswanger, and others, of its being a *parenchymatous encephalitis* and the vascular and glia changes secondary to the nerve cell degeneration. The fact that general paralysis and tabes have the same pathogenesis is now recognized, and it is interesting to note that the same process of evolution of knowledge of the pathological process in these two diseases took place; for tabes was at first regarded as a chronic interstitial inflammatory change of the posterior columns, a sclerosis which led to degeneration of the nervous elements, but now it is regarded by most authorities as an *elective* dystrophy of the afferent spinal protoneurones. In the etiology of parasyphilitic affections we have seen how gradually it has been shown that the observations of Esmarck and Jessen of the syphilitic origin of general paralysis have been substantiated, mainly in the first instance by Fournier; and at the present day there are few alienists or neurologists who do not accept syphilis as the principal cause; a large number indeed recognize it as the essential cause.

Symptomatology and course. The clinical history of general paralysis varies considerably. There are many types, but there are a few phenomena which are almost always present. (1) Progressive dementia usually accompanied by mental exaltation, sometimes by depression. (2) Unequal, generally irregular, pupils, reacting sluggishly or not at all to light, but reacting to accommodation. (3) Progressive paresis with tremor especially affecting the tongue and face muscles. (4) Hesitant, tremulous, slurred speech with elision of syllables, and similar affection of handwriting. (5) Altered knee-jerks, generally exaggerated, sometimes absent on one side; more often on both sides.

The *discovery of the disease* does not really indicate the commencement of the disease; there may for some time previously have been a slow insidious and progressive dementia affecting *all* the mental faculties, aesthetic, moral, intellectual, and volitional generally, not in an equal degree in each individual. It is quite exceptional for general paralysis to manifest itself suddenly by symptoms, unless it be by an apoplectic or epileptiform seizure. More often there is a prodromal, pre-paralytic period which extends from the time when the patient first shows some abnormality up to the time of the appearance of distinct mental or bodily symptoms. It is very difficult to decide exactly when this prodromal period began and when it terminated; it is necessary to know the behaviour of the individual during that time; again, only those closely connected by family ties, profession or business, are able to judge whether there is any change in the individual's moral or intellectual faculties, whether his memory has been failing or there has been a failure of will-power and self-control. Among the better classes of society this may have been perceived, but among artisans and the poorer classes slight psychical and somatic symptoms are easily overlooked. The duration of the prodromal period in any given case may therefore be extremely difficult to decide, but there is no doubt, according to my experience, that it is very variable, it may only be a few months, but I have known cases in which it has persisted for several years. Ballet has particularly insisted upon the possible long duration of this period.

The symptoms of the prodromal period may be considered under two headings, psychic and somatic.

Psychic symptoms. A modification of conduct and character occurs, the patient becomes depressed, irritable, ill-tempered, moping, preoccupied, and hypochondriacal; he may complain of ill-defined pains in various parts of the body. Sometimes he is somnolent and apathetic, sitting for hours brooding, heedless of his surroundings and answering only in monosyllables. He may complain of weariness and lassitude, and of being easily fatigued; again, the wife has often told me that in the early stage of his illness he felt apprehensive of himself and would not leave her for fear something might happen to him. At this period there is generally some failure of memory, he forgets where he has placed things, what has recently happened, whom he has recently seen, and what he has said; consequently he may get into trouble with his employers, or his business or professional reputation may suffer. During this early stage there is usually evidence of slight intellectual failure. There is not the same power of attention and of taking in his surroundings that there formerly was. His apperception is not as sharp and clear, he misses the point in an argument and fails to appreciate a witticism. Following the depression and occasionally alternating with it is excessive mental activity, the patient is full of new ideas and schemes, his mind is engaged in projects of all kinds; neglecting his business, profession, and family, he may launch into speculation and large purchases of goods for which he has no use, or he may give himself up to venery, debauchery, and even depravity. At this period abuse of alcohol is very frequent; hence at the commencement of general paralysis, toxic disturbances frequently complicate the clinical picture, making the diagnosis more difficult. A *hyperaesthesia sexualis* is very frequent, and a man who is married and has led a blameless life may consort with prostitutes, and sometimes indeed the disease is discovered by the patient being charged with immoral acts and indecent assaults. Sometimes there is impotence, and the increased sexual desire combined with impairment or loss of function causes him to resort to criminal acts which may bring him into the police court. He may get into trouble by acts of theft or drunkenness, or he may be charged with attempted suicide, manslaughter, or homicide.

The loss of control and impulsiveness is in a large number of cases aggravated by alcohol, so that he becomes a danger to himself and others ; yet it is not uncommon at this period to find that the patient is not unconscious of his morbid state, and it may be difficult to certify him as of unsound mind as he may apprehend the object of your visit and take care not to give himself away. Yet this period, which has been termed the medico-legal period, is the very time he should be placed under control. A careful examination may detect some dementia and somatic signs, and the friends, especially the wife (if he is married), may give information which will enable the diagnosis to be made. Moreover, it often happens that owing to the suggestibility of these patients grandiose ideas are easily revealed by trying various suggestions.

Somatic disturbances. Apoplectiform, epileptiform, or congestive seizures may be the signal of oncoming general paralysis. I have known cases in which such attacks have preceded several years the definite signs of *dementia paralytica.* Sometimes the attacks are slight like fainting fits or attacks of giddiness ; at others they are more severe and like apoplexy, the patient being suddenly struck down unconscious, and he may so remain for hours or even a few days. This may be followed by a hemiplegia which, however, is in the great majority of cases transitory and lasts only a few days or a few weeks. When it is a right-sided hemiplegia it is frequently associated with aphasia or paraphasia. Occasionally without any loss of consciousness the patient becomes suddenly aphasic ; to his astonishment he finds he can neither speak nor write ; this speech defect may last a few minutes, a few hours, or a few days, and then pass off to reappear again on some future occasion. There may be the power to utter articulate words, but the wrong words are used, or there is repetition of a word or a syllable, and not infrequently after several of these attacks of aphasia or paraphasia the definite speech defects of paralysis become plainly manifest. In other cases epileptiform attacks occur; these may resemble true epilepsy or they may resemble Jacksonian epilepsy due to spread from a local focus of irritation; they may be of a motor or sensory type. Sometimes, and according to my experience frequently, there is an initial conjugate deviation of the head and eyes, and this is followed by clonic spasms spreading to the face, arm, and leg of the same side. If the patients do not suffer with these seizures in the early stage of the disease they are very liable to do so later.

Charcot pointed out that migrainous attacks with supraorbital headache and vomiting, and in which transitory hemianopia, aphasia, or paresis of the limbs occurs, are liable to occur in the prodromal stage of general paralysis. Blocq has shown that these migrainous attacks may occur also when the disease is pronounced. Again, transitory ptosis, strabismus, and diplopia may occur. The pupils may be unequal, irregular in outline, and one or both either sluggish in action to light or inactive whilst active to accommodation; it is not uncommon, however, to find the pupils quite normal in the early stage. Sometimes on removing the shading hand the pupils dilate for an instant—' the springing pupil '.

The patients may complain of neuralgias—especially trigeminal neuralgia affecting one or several of its branches; headache is not uncommon, the patients complaining of a tight feeling around the forehead like that produced by a tight-fitting hat. Often they complain of dyspepsia and a general loss of sense of well-being, and this is expressed in their physiognomy by an air of weariness and lassitude. They are troubled by insomnia and broken unrefreshing sleep which it is difficult to relieve by hypnotics; again, they may be troubled by nightmare and dreams, evidence of imperfect rest of the seat of consciousness. While insomnia is most common, somnolence and drowsiness afflict others. In many respects the patient resembles a neurasthenic, and Ballet has insisted upon the importance of recognizing this neurasthenic form of the prodromal stage of general paralysis. In some cases tabes dorsalis may precede the onset of the mental symptoms.

A correct diagnosis of general paralysis in the prodromal and early stages may be of very great importance; for momentous issues may arise in relation to responsibility. Medico-legal questions, as we have seen, involving criminal responsibility and testamentary validity may arise; moreover, social and family questions relating to marital responsibilities and duties, professional and business capacities, partnerships, &c., may necessitate an unqualified opinion as to whether a patient is suffering from this fatal disease. Of even greater importance is the decision of the medical man when a patient is brought to him occupying a position of public trust involving the lives of the community, e.g. engine drivers, signalmen, station masters, pilots, and captains of vessels, chauffeurs and mechanicians. The danger, moreover, is all the greater from the fact that sometimes these men may, by a process of psychic automatism engendered by habitually reacting in the same way to the same stimulus, be able to carry on their occupation to the satisfaction of their employers even when they are well advanced in the early stage of the disease; it must be remembered, however, that although this psychic automatism may allow a man who is demented and even slightly paretic to carry on his occupation, yet it in no way exempts him from being totally incapacitated at a critical moment by an apoplectic, epileptiform, or congestive seizure.

The disease sometimes suddenly but unmistakably declares itself by a seizure in some cases; in others by the sudden onset of expansive delirium and exaltation, or much more frequently *gradatim* the essential somatic and psychic symptoms of ataxic paresis and progressive dementia become plainly manifest and the patient enters into the *first stage* of the pronounced disease.

First stage of pronounced disease. Somatic symptoms. The physiognomy of the paralytic may at the very onset lead the physician to a correct diagnosis; for frequently 'there is no art to find the mind's construction in the face' (vide Fig. 22.) Sometimes the face shows a silly imbecile, atonic expression accompanied not infrequently by an expression of elation or beatitude, or it may present a stupid drowsy expression in consequence of a semi-paretic muscular hypotonus, affecting the supply of the upper facial and common oculo-motor nerves, causing a tendency to drooping of the eyelids and narrowing of the palpebral fissures, and in consequence an elevation of the eyebrows, accompanied by transverse furrows of the forehead as if just arousing from sleep. Sometimes there is a wild, excited, and exalted expression continuously exhibited ; at other times the wearied, expressionless mask denoting dementia may suddenly change to a wild, exalted expression when the patient's mind is aroused. Asymmetry of the two halves of the face or one angle of the mouth lower than the other may be observed. Spasmodic tremors and fibrillary contractions are often noticeable in the face, especially at the commencement of articulation of words, such as the explosive lip-sounds ; they are often, indeed, provoked by silent thoughts or by an intention of speaking. They may also be observed when the patient is asked to perform some

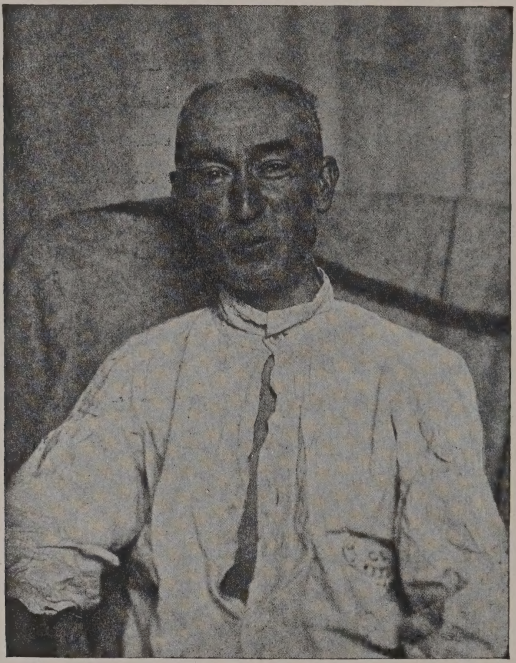


FIG. 22. The photograph illustrates a condition of marked exaltation and grandiose delirium; at the time this was taken the patient was telling me that his brain was geared up to 990,000.

movement such as to show the teeth, close the eye, put out the tongue.

The examination of the pupils may afford most valuable objective signs. Joffroy and Schramek, Piltz, and many others have recently shown the importance of the irregular pupil in the diagnosis of early cases of tabes and general paralysis, and this irregularity may precede all other signs. The irregularity may be continuous or only transitorily manifest when the light reflex is tried. The pupil, instead of being circular, is irregularly angular and, owing to the unequal tension of the muscular structures of the iris, it may be displaced from its central position, and become more or less eccentric. The pupils are usually unequal in size, and this may attract the observer's attention (vide Fig. 23).

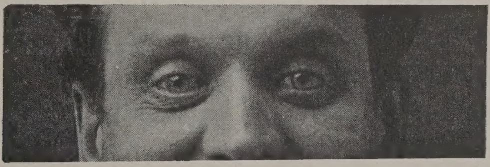
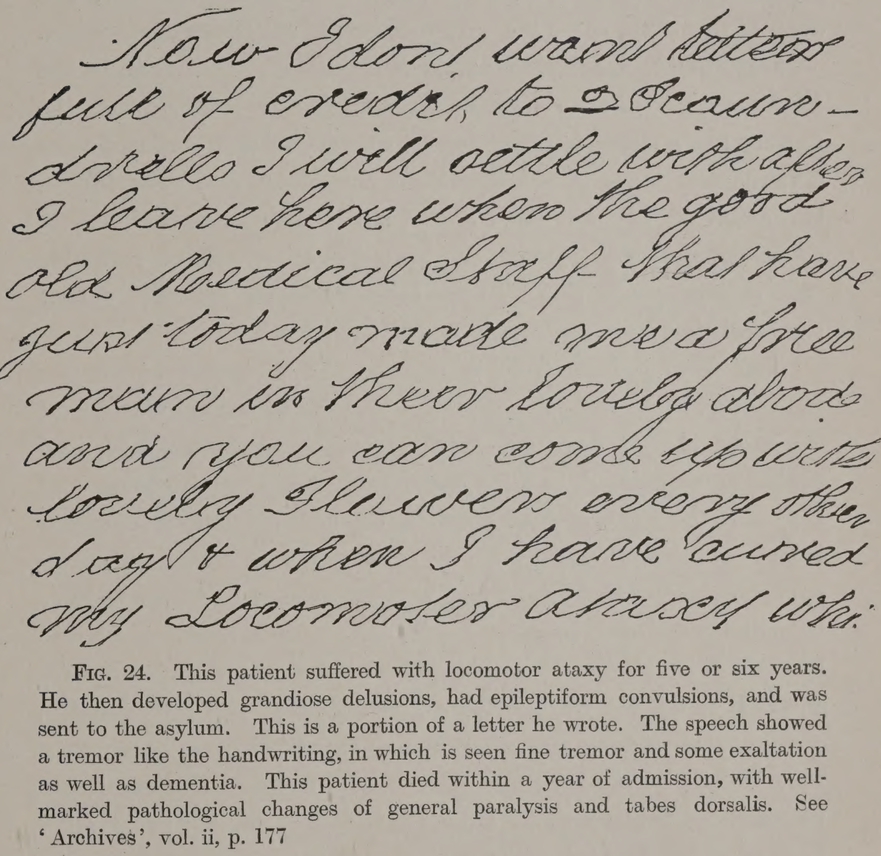


FIG. 23. Photograph of the upper part of the face of a paralytic with marked exaltation and grandiose ideas—the greatest actor, the greatest athlete, and the strongest man in the world. If even only the eyes are looked at, there is a marked expression of elation. Close inspection shows that the right pupil is larger than the left.

Upon shading the two eyes and exposing one to the light a contraction in the other will not be observed ; sometimes the contraction is sluggish only ; sometimes no response to light occurs on removing the shading hands from both eyes. The pupils, however, react to accommodation (Argyll-Robertson phenomenon), but not infrequently upon removing the shading hand the pupils for a brief moment dilate (paradoxical pupil). Kräpelin states that Räcke found in 18 per cent. of paralytics there was transitory paresis of eye muscles. I should have thought this rather a high percentage. Complete ophthalmoplegia only rarely occurs ; I have seen several cases, one of tabo-paralysis in which there was bilateral ophthalmoplegia. According to the Berlin statistics difference in size of the pupil occurs in 57·5 per cent., reflex light rigidity in 34 per cent., very sluggish reaction in 35·5 per cent. of the cases. Siemerling gives the pupil rigidity as 68 per cent. There is no doubt that many cases on coming to the asylums have pupils which react to light but subsequently lose the reaction ; and this may account for the difference in the statistics of different observers. I should say about one-half have the Argyll-Robertson pupil phenomenon. There is often a tremor in the hands and when the patient is asked to put out the tongue it is protruded in a succession of jerks (saccadée) and there are usually marked fibrillary tremors.

Along with the early mental symptoms, generally after, but sometimes even before, apparent alterations of speech may be observable. There is at first a hesitancy which may only be perceptible to practised ears, but in which there is no real fault of articulation once it is started ; sometimes preparatory to, and during the utterance, there is a tremulous motion of the muscles about the mouth. The hesitation increases and instead of a steady flow of modulated articulate sounds, speech is broken up into a succession of irregular, jerky, syllabic fragments without modulation and often accompanied by a tremulous vibration of the voice. Syllables are dropped out, blurred, run into one another, or imperfectly uttered ; especially is difficulty found with consonants, particularly explosive sounds *bs*, *ps* ; again, linguals and dentals are difficult to utter. To ascertain the existence of speech defects various test words are used, e.g. preliminary, Mississippi, biblical criticism, Irish artillery, parallelogram, terminological inexactitude, &c. It is very seldom that a paralytic can utter all these without difficulty and exhibiting defect of speech.

Similar defects occur in written as in vocal speech. The syllables and even the letters are disjointed ; there is a fine tremor in the writing and an ataxic paresis in the fine movements of the pen. His silent thoughts leave out syllables and words in the framing of sentences, consequently they are not expressed by the hand. The subject matter and the writing in a letter (vide Fig. 24) may form a valuable indication of the mental state and may of itself serve as a means of diagnosis. The ideation of a written or spoken word is based upon the association of the component syllables, and the difficulty arises primarily from the impairment of this function of association upon which spoken and written language largely depends. The speech affection is almost pathognomonic of the disease ; it is not, however, always present in the early stages. In the first stage the motor troubles of the limbs in gait and station and for habitual manual operations



Now I dont want letters
full of credit, to a Scoun-
drells I will settle with after
I leave here when the good
old Medical Staff that have
just today made me a free
man in their lovely abode
and you can come up with
lovely Flowers every other
day & when I have cured
my Locomoter ataxy whi

Fig. 24. This patient suffered with locomotor ataxy for five or six years. He then developed grandiose delusions, had epileptiform convulsions, and was sent to the asylum. This is a portion of a letter he wrote. The speech showed a tremor like the handwriting, in which is seen fine tremor and some exaltation as well as dementia. This patient died within a year of admission, with well-marked pathological changes of general paralysis and tabes dorsalis. See ‘Archives’, vol. ii, p. 177

are usually only slight or they may be entirely absent ; as a rule the patient is able to take plenty of physical exercise and to exhibit on occasions considerable muscular strength. The muscles at first are not wasted, but the knee-jerks are usually exaggerated on both sides ; in tabetic cases they may be absent on both sides or absent on one side and present on the other. Ankle clonus and the Babinski sign are very rarely present. The muscles react normally to the faradic and galvanic currents, and even in the terminal stages when the body is extremely wasted there is no reaction of degeneration. But it must be remembered that an essential feature of the disease is a progressive paresis of voluntary movement, and as the disease proceeds the patient's movements become more enfeebled and he walks with a shuffling, shambling, tottering gait. The patient is able to swallow, but even at this stage there is a complete loss of the pharyngeal reflex.

Seizures are very liable to occur even more often than in the prodromal period; they are of three kinds: *congestive*, when the patient has a slight fainting fit or becomes dull and confused with a temporary lapse of consciousness, *apoplectic*, and *epileptiform*, characterized by convulsions with incomplete or partial loss of consciousness; the convulsions may be unilateral or resemble true epilepsy, and one fit may follow another so rapidly that the condition is one of status epilepticus.

The face is flushed in a seizure, the temperature raised; the cornea is often quite insensitive and the breathing stertorous. These seizures, I have observed, are often associated with and probably dependent upon a secondary microbial invasion and toxaemia the result of pneumonia, of broncho-pneumonia, of tuberculosis, of institutional dysentery, of cystitis with secondary pyelonephritis, and of bed-sores; and when it cannot be shown to have been due to one of these affections the cause may be sought in a bowel loaded with scybalous masses, a pyorrhoea alveolaris, an infective gastritis or duodenitis, causing autotoxaemia. Not infrequently, owing to secondary microbial infection or seizures, there may be for days or weeks some degree of continuous or remittent pyrexia. A typical temperature chart from a rapidly progressive case of general paralysis is shown in Fig. 25. When dysentery was rife in the asylums numbers of paralytics suffering with acute dysentery died in the *status epilepticus*, and it was only at the autopsy that the acute dysenteric condition was discovered. Again, the reinfection or reawakening of an old tubercular focus or a recent infection of the lung causing acute tuberculosis, often with associated infection by pyogenic organisms, can be proved by clinico-anatomical observations to be the cause of the pyrexia

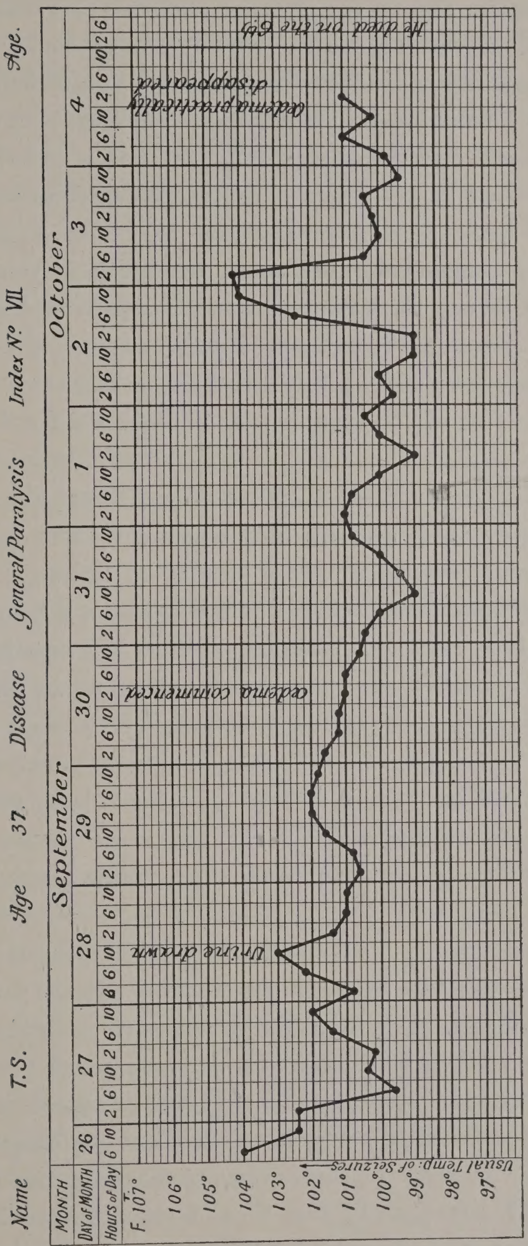


FIG. 25. Typical Temperature Chart from a rapidly progressing Case of General Paralysis.

and seizures. These seizures may be mistaken for apoplexy or uraemia, but the age of the patient and the previous history, together with a careful clinical examination, should enable a correct diagnosis to be made. Frequently the patient dies in the seizure, but if he recovers it is usually observable that the dementia is more profound and the paresis more marked; and this is not surprising, for the vascular stasis and the perivascular infiltration will have led to neuronic degeneration.

Following congestive, apoplectic, or epileptic seizures are temporary but very rarely permanent conditions of hemiplegia, monoplegia, hemianopia, alexia, aphasia, apraxia, asymboly, paraphasia, jargonaphasia, psychical blindness, and word-deafness. As a rule the loss of function is not of more than a few days' or a few weeks' duration. Occasionally after a hemiplegia the knee-jerk which was absent may return on the paralysed side, and occasionally these seizures may cause sufficient destruction of the pyramidal system of fibres or the cortical psycho-motor neurones to produce ankle clonus and Babinski's sign on one or both sides; it is, however, very rare to find this sign in general paralysis. I should think that it did not occur in more than 2 per cent. or 3 per cent. of the cases; if it be present it would point rather to the disease being pseudo-general paralysis. The patient in this stage of the disease may for a time still retain control over his bladder and bowel, and attend to the calls of nature; very much depends upon the degree of dementia whether he is clean in his habits.

Psychic symptoms. The mental symptoms of general paralysis occur early in relation to other signs of the disease; they are irregular, remittent, but progressive; the remissions that occur, or the disappearance of phenomena and groups of phenomena of an episodic transitory nature due to toxic or autotoxic causes, may lead to the belief in some cases that a wrong diagnosis has been arrived at or that the disease has undergone arrest or even been cured. We frequently find these remissions attributed to treatment by injections of serums, and to the action of drugs or anti-syphilitic remedies, e.g. mercury and iodide, and even external applications, e.g. Thorium caps; but often a careful investigation will show that the fundamental basis of the disease due to neuronic destruction, viz. the dementia and paresis, still remains although the halo of functional disturbance manifested by delirium due to toxic conditions may have subsided. Raymond says: 'Since I have given up pursuing the chimera of specific treatment of general paralysis, I have observed the same apparent alternations of the disease by particular attention being given to avoid auto-intoxications, especially those of intestinal origin.'

The delirium. It is comparatively seldom that paretics suffer with hallucinations as a result of the disease; visual hallucinations are not at all uncommon in patients admitted with acute mania, but these hallucinations are due to the effects of alcohol and sometimes drugs such as morphia and cocaine. It is exceedingly difficult to decide in the first few days or even in a week or more whether the delirium of acute mania is due to alcohol alone or whether it is a case of general paralysis complicated by *mania a potu.* In the chapter on diagnosis allusion will be made to typical cases. Auditory hallucinations do occur, but they are much more common in *dementia praecox,* manic-depressive insanity, and paranoia. Tabo-paralytics have not infrequently visual hallucinations, and it is common for them to put an insane interpretation upon the lightning pains and the visceral crises; still, it must be admitted that tabetics in asylums that have these systematised delusions of persecution, unless they exhibit indubitable signs of dementia, are not clinically speaking tabo-paralytics.

The delusions of general paralysis. A striking feature about the delusions of a paralytic dement is the fact that he is not in the least embarrassed by contradiction, he is continually talking of what he is going to do, but makes no attempt to commence to act; while boasting grandiloquently of his millions, of his diamonds, of his kingdoms, he will not think it illogical the next moment to beg for the money to buy a pipe of tobacco. The delusions usually derive colour from present events; consequently aeroplanes, flying ships, wireless telegraphy, Dreadnoughts, Kings, and Kaisers, would at the present day afford the subjects of his fantastic fabulation. This grandiose delirium has always been recognized as a special feature of the disease; but there are always a small percentage of cases which have delusions of persecution and exhibit marked depression and hypochondriasis, and just as in the megalomania no superlatives suffice to express their grandiose exaltation, so in the melancholic form no superlatives may suffice to express the depths of the patient's distress, and misery. No amount of argument will convince him otherwise. Another feature about the delusions of a general paralytic is that he is in the highest degree mobile and suggestible; a few minutes' conversation suffice for the revelation of his delusions and, entirely unlike the paranoiac, he changes from one to another upon suggestion. Delirium with either exaltation or depression may persist through the whole course of the disease; the one state may alternate with the other, or the one may permanently depose the other.

In some cases of the slow dementing form the delirium may be absent altogether, and not at all infrequently, when the patient becomes profoundly demented, his delusions are either lost or not apparent.

Dementia. The most constant symptom is dementia; it is a slow, progressive, but certain enfeeblement and final effacement of every function of mind; this loss of mind is proportional to the loss of cortical grey matter, the anatomical substratum of consciousness. Before the decay and decadence of the perceptual and conceptual psychic fields there is an *intrapsychic dissociation* which is manifested in these patients by a progressive and continuous loss of the notion of analogy and of contrast, of comparison and of proportion; consequently their powers of criticism, judgement, and control wane, likewise their orientation in time and space. The paralytic thinks and speaks of the present, seldom of the future, rarely of the past. His mind is in a state of disordered and unconscious automatism, and this accounts for the multiplicity, mobility, suggestibility, incoherence, confusion, and absurdity of the mental state met with so frequently in this form of dementia. Psychic synthesis is no longer in operation; 'there is juxtaposition of isolated concepts, without combination of associated ideas' (Dupré). A striking feature is the marked contrast between the present and past personality of the patient ; his habits, mode of life, behaviour, and aesthetic tastes are changed. Often this is the first indication noticed by the wife, the partner in business, or the colleague or fellow workman ; it constitutes the *medico-legal period.* Another early constant and continuous psychic change in an individual suffering with paralytic dementia is the weakening and final disappearance of the consciousness and faculty of criticizing his own acts, behaviour, and conduct. Moreover, besides this loss of *auto-criticism,* the paralytic is unaware of the profound change which has taken place in his own personality and of his intellectual decadence, even when confronted with the most obvious proofs ; he pays no attention to being told that he is unable and unfit for these reasons to continue his avocation ; if he is charged with unseemly behaviour and conversation or antisocial conduct, he is heedless, often passing off with a ribald joke or an oath remarks made thereon by friends or strangers. As Dupré aptly expresses it, 'he becomes as it were another personality without himself knowing it.' Another mental characteristic, not however peculiar to general paralysis, but of which the consequences in this disease are more important and interesting to observe than in other forms of dementia, is the preservation of *psychic automatism,* a condition which has already been alluded to in discussing undiscovered *general paralysis* and responsibility, p. 241.

The patient may suffer with progressive dementia and paresis, and, having no marked toxic delirium, the psychic automatism permits him to assume regularity of life, punctuality in habits, the common observances of social politeness, and even the performance of habitual professional or industrial occupations ; thus he may, if he keeps from alcohol and does not suffer from auto-toxaemia, retain his position or occupation and remain in the family circle and society even when fairly well advanced in the first stage of the disease. The process of mental decay having been thus slowly evolved, relations and friends are often only too ready to believe what they wish to believe, and unconsciously accommodating themselves to his altered character they gradually acquire the illusion that he is not of unsound mind, but suffering from either brain fag, neurasthenia, or nervous exhaustion, the results of overwork, worry, and sleeplessness. They think he will soon be restored by rest or by a voyage, and when the physician after examination tells them that he is of unsound mind and suffering from general paralysis of the insane, a disease that will in a few years certainly prove fatal, they are often so astonished as to seek other advice.

Psychical automatism in a demented person, enabling him to perform habitual acts of regular and professional life, proves that a great number of our daily acts have by constant repetition been in great part relegated to subcortical centres. This psychic automatism occasionally exists combined with a dementia which renders a paralytic incapable of deliberation, judgement, and highest control, and not infrequently it terminates in curious as well as unfortunate consequences. Incapable of personal initiative (apart from states of excitation or delirium), the patient is often suggestible, imitative, euphoric, and generous, and he may be induced readily to dissipate his money and property, and worse than that any other person's property he may be able to use. Sometimes the paralytic appears to participate in the psychic activity of his associates ; it usually, however, is but a mimic reflection of their words and facial expression, for without understanding the conversation he takes part by look and gesture, laughing when his associates laugh, looking serious when the others do, and assuming an air of surprise when they are astonished ; nevertheless he is only an unconscious automaton whose reactions are an illusion to his friends and acquaintances, who believe them to be voluntary and personal.

A striking feature of the dementia of general paralysis is the fact that usually it is quite safe to speak in his presence of his disease and its probable course and termination, without his comprehending. In the asylum he does not recognize that the inmates are lunatics, and this is due to a 'bien être' and a *moral optimism* which, conjoined with a complete lack of intellectual comprehension of conversation, is especially characteristic of paralytic as distinct from organic dementia.

In the second stage of the evolution of the disease, the patient may put on flesh and for a time remain in the fat and fatuous condition ; the skin is moist and greasy-looking, the face is often flushed, the appetite may be voracious and not only will he gorge all the food he can get but will steal his neighbour's if he has a chance. He masturbates frequently, often shamelessly and continuously. He does not obey the calls of nature and is wet and dirty in his habits, therefore requires constant attention to keep him clean. He takes but little or no interest in his surroundings, and he has little or no knowledge of time or place. He may be able automatically to multiply figures, e.g. to tell you that 3 × 6 is 18, but if you then ask him what is 6 × 3 he will not know or answer incorrectly. He may recognize individuals and name objects correctly, but he can exercise no judgement or comparison. Sooner or later, if he has not died from some complication or intercurrent disease, he passes into the third cachectic terminal stage ; at first he may be able to sit all day in a chair ; his gait if he is able to walk is tottering, shuffling, and shaky, and he is liable to fall and injure himself ; he has *to be fed*, minced food being employed or he might be choked from swallowing a piece of meat unmasticated. There is nothing more pitiable and degrading than the sight of a number of these wrecks of humanity sitting in a row, their heads on their breasts, grinding the teeth, saliva running out of the angles of the mouth, oblivious to their surroundings, with expressionless face and cold livid expressionless immobile hands. Either from asthenia (or owing to acute or chronic disease of viscera) the patient becomes unable or too feeble any longer to sit or stand, and he passes from the paretic into the paralytic bed-ridden stage with all his organs and tissues wasted, with contracted limbs and emaciated body, hollow-eyed, totally demented and often completely speechless, with pulse so feeble as hardly to be felt, respiration so shallow as scarcely to be perceived ; each respiration apparently the last gasp, yet for days and even weeks he may thus linger until the jaw drops and no further inspiratory gasp occurs, announcing the fact that the vital spark has at last died out. The average time elapsing between the onset of symptoms and death from asthenia is about five years, but usually this period of time is much shorter owing to the liability of death from complications and intercurrent diseases. Women as a rule live longer than men, the liability to bladder complications is less; apart from this the disease runs a slower course. I have known a few cases which have lived twelve or even more years after admission to the asylum with the initial mania of general paralysis, but such cases are very rare. Sometimes a patient dies within one to three months after the diagnosis has been made; usually these cases have suffered with seizures, or have had some intercurrent disease. Occasionally they die from exhaustion of mania; no doubt in some cases accelerated by hypnotics, e. g. hyoscin and sulphonal.

Morbid anatomy and pathology. A patient dying of asthenia in the third stage is extremely emaciated; no naked-eye disease of the organs may be found, but there is an extraordinary wasting of all the viscera and tissues including the blood. Very much the same as might be found in a case of death from famine, except that in death from famine the brain and spinal cord show hardly any wasting, whereas in paretic dementia the whole central nervous system exhibits an extraordinary degree of wasting in a long protracted case dying of uncomplicated asthenia. In the large bulk of cases of general paralysis lung disease, in the form of bronchitis, broncho-pneumonia, pneumonia, gangrene, and tuberculosis, is found at the autopsy and certified as the immediate cause of death. Other conditions are found and the most frequent and important is atheroma and nodular fibrosis of the aorta; but the appearance of the organs generally indicates that as a rule, especially in males, the patient, prior to the onset of the brain disease, was physically in a healthy condition; the lung complications so frequently found being the result of the demented condition and lowered vitality. The signs of tertiary syphilis on the surface of the body are singularly few as compared with syphilitic brain disease; likewise it is rare to find any evidence pointing to visceral gummata or syphilitic bone disease, although there may be a well-marked history and scar on the penis.

Upon removing the skull cap it is often noticed that the diploe is denser than natural, contrasting with the fragility of the ribs, which can in many cases be broken between the thumb and finger with the greatest ease. The dura is often adherent to the skull cap and it is difficult to tear off the sawn-through calvaria; after this has been done the wasting of the brain is obvious, even before opening the dura mater; for the cerebrospinal fluid in the subdural space now tends to gravitate and there are folds and depressions in the dura over the frontal regions. On slitting up the dura an excess of cerebro-spinal fluid escapes, and if the patient has recently had seizures, a film of recent or old blood-clot of varying thickness and extent may be observed forming a membrane which may or may not be adherent to the dura mater; it is usually partially organized and newly formed vessels in a laminated clot may exist. One of these possibly has given way and recent haemorrhage may have taken place into the laminated membrane forming as it were a *haematoma.* It is often thought that this condition of *pachymeningitis haemorrhagica* is a very common condition in *dementia paralytica* and will be found in all cases where seizures have occurred. Such is by no means the case; it is not a common condition; according to my experience it has greatly diminished in frequency since I have been connected with lunacy, and I attribute this fact to the increased care of the attendants in preventing falls and head injuries; for *pari passu* with this decrease has been a remarkable decrease in frequency of *haematoma auris.* Blood tumours of the ear were once looked upon as an unavoidable complication of general paralysis; they were seldom seen, however, on the female side; they occurred with undue frequency in certain wards with certain attendants, and an unusual number of such cases denotes either carelessness or cruelty. The same may be said regarding an undue frequency of broken ribs—after this digression we will revert to the description of the brain which we will now suppose is exposed, and it will be observed that the pia-arachnoid membrane has a thickened opalescent appearance; the sulci are distended with fluid which *appears* like skim milk; but really this appearance is due to the thickened membranes, for the fluid which is contained in the subarachnoid space is in great excess, and when it escapes as it will do upon removal of the brain, it will be found to be only slightly turbid or it may even be fairly clear.

On removing the brain, fluid will still escape and the hemispheres partially collapse, owing to the distension of the lateral ventricles with fluid. Upon weighing it will be observed that the brain, which usually is of a complex convolutional pattern, denoting a good intellectual capacity before the onset of dementia, is considerably below the average weight. If now the peduncles be cut through so as to separate the pons, medulla, and cerebellum, and then the two hemispheres be divided through the corpus callosum in the mid line, and each of these severally weighed, it will be found that the hemispheres have proportionally lost weight much more than the pons and cerebellum. The normal index of the weight of the pons and cerebellum is one-eighth of the total weight of the brain; in an advanced case of general paralysis it may be one-sixth. The two hemispheres as a rule are unequal in weight, and it will generally be found if the patient has suffered with marked and early speech defects that the left hemisphere weighs considerably less than

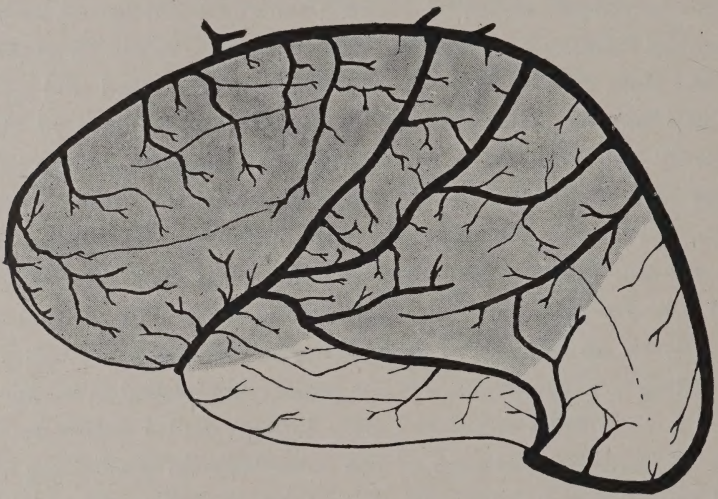


Fig. 26 a. External and upper surface of hemisphere, showing distribution of veins. The shading shows the usual area of pia-arachnoid thickening. A large branch is seen running back into the lateral sinus, connecting it with the great central anastomotic vein. The lateral sinus is diagrammatically represented as continuous with the longitudinal sinus, and the torcular is not shown.

the right; moreover, if he has had epileptiform seizures affecting one side of the body and terminating in a temporary hemiplegia or permanent hemiparesis of one side, then the opposite hemisphere will have lost more weight than the other. As a rule the hemispheres do not show an equal degree of wasting; consequently the weights are unequal, and the left hemisphere is more often the less heavy of the two, although normally the right and left hemispheres are of equal weight. If the post mortem has been made soon after death and before *rigor mortis* is well established the pia-arachnoid can be stripped with ease as an oedematous, thickened, and vascularized membrane; should, however, *rigor mortis* have set in, then the membrane is adherent to the subjacent cortex and stripping leaves erosions of a characteristic appearance (vide Plate XIX). The thickening of the pia-arachnoid membrane is most marked over the fronto-central convolutions and the mesial surface in front; likewise the atrophy of the convolution is most marked in these regions. There are two explanations for this which I have pointed out, viz. the region corresponds *nearly* to the arterial

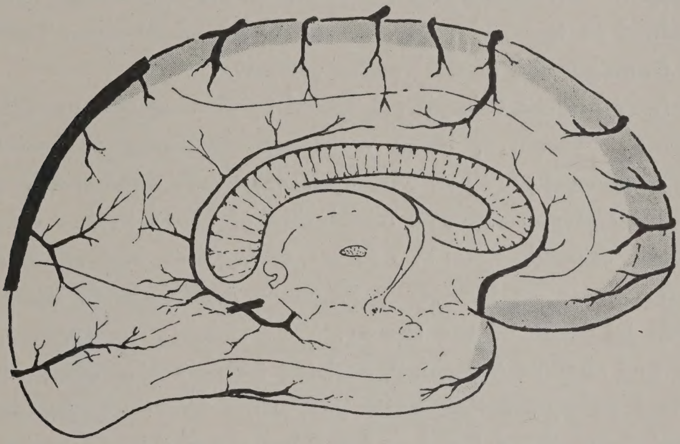


FIG. 26 B. Mesial surface of hemisphere, showing the veins opening into the longitudinal sinus draining the upper portions, where the thickening of the pia-arachnoid occurs. Only a small portion of the longitudinal sinus is represented. These drawings are from Testut, modified to show the area of pia-arachnoid thickening and its correspondence in great measure with the area drained by veins opening into the longitudinal sinus.

supply of the internal carotid artery ; it also corresponds to the portion of cerebral cortex the venous blood of which drains into the longitudinal sinus. The accompanying diagrams (Fig. 26) illustrate these facts. It will be observed that the shaded part corresponds to the portion of the brain where the thickening of the membranes is most marked and that this area is drained of venous blood by veins opening against gravity into the longitudinal sinus ; moreover, the veins embouch in a direction opposite to the current ; the largest branches often pass for an inch or more through the substance of the dura-mater, and the chordae Willisii contained in these sinuses and the longitudinal sinus itself all tend to stagnation of the venous current.

I have noticed this pia-arachnoid thickening also in epileptic dements ; moreover, these veins are especially congested in cases of general paralysis with epileptiform seizures and in cases of *status epilepticus*. The circulation of blood in the veins of the brain depends upon two forces, *vis a fronte* and *vis a tergo* ; the former is an important influence and depends upon the suction influence of the thorax. The liability to seizures, the weak and shallow breathing, and the feeble action of the heart all tend in conjunction with the before-described anatomical conditions of the arterial and venous circulation to make this region the area in which venous stasis is most likely to occur. Thus a vicious circle is established in which decaying neurones are supplied with an imperfectly oxygenated blood ; the products of decay accumulate and irritate the perivascular lymphatics leading to cell proliferation which again tends to produce mechanical congestion.

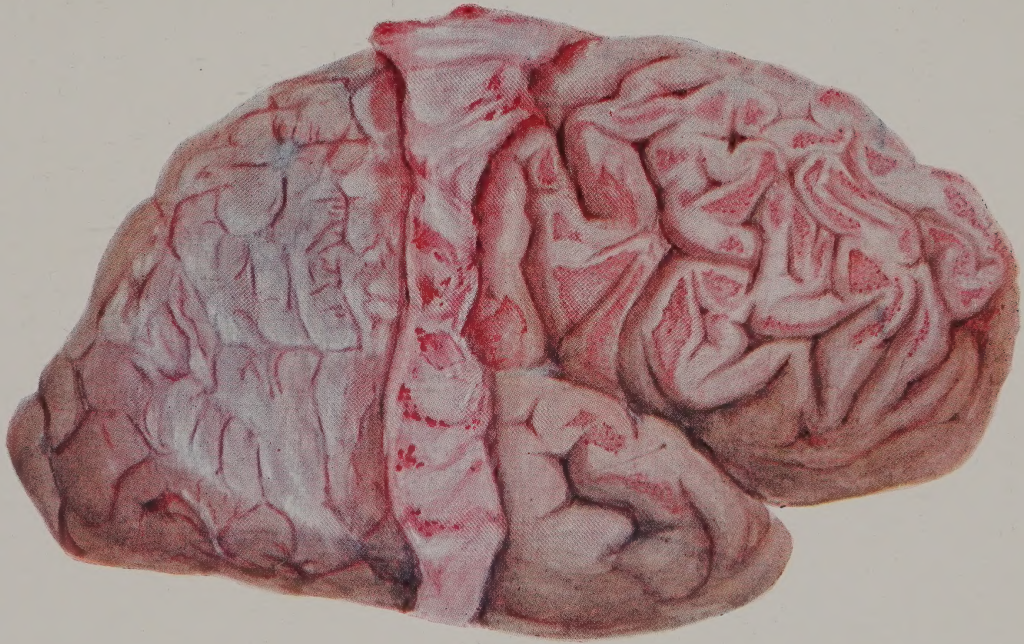
After stripping the membranes it will be found that the hemispheres have lost a considerable amount in weight, it may amount to as much as 50 to 100 grams per hemisphere. Examination of the grey matter of the cortex shows it to be diminished in thickness ; it is of a dull pinkish-grey colour owing to increased vascularity and the normal striation, e.g. the line of Gennari in the calcarine region which in the normal brain is seen so readily with the naked eye is hardly perceptible, also the line of Baillarger in the grey matter of the central convolutions cannot be seen.

PLATE XIX.

Brain of a fairly advanced case of general paralysis, showing the thickened membranes separated and folded back from the anterior half of the brain. It will be observed that the whole cortex is much redder than natural, and that numerous erosions have occurred on account of the stripping. These erosions do not take place if the brain is examined soon after death, before rigor mortis sets in. Over the parietal region the thickened opalescent pia-arachnoid membrane is seen, and it contrasts with the appearance presented by the occipital lobe.

To face p. 280.]

PLATE XIX.



The white matter is softer and more watery than natural, and the ependyma of the lateral ventricles usually shows fine granulation on the surface like sand-paper. By far the most characteristic and most frequent naked-eye character of general paralysis is to be found on cutting through the mid line of the cerebellum so as to expose the whole of the floor of the fourth ventricle; the lateral sacs will be found dilated and in a typical case the whole of the ependyma has a frosted appearance; it has also been likened to a cat's tongue (vide Fig. 27). This sign is very seldom absent, but it may not be present in a case that has died from some complication early in the course of the disease, so that it is not absolutely pathognomonic; moreover, I have seen it in chronic cases of insanity and not infrequently in cases of chronic brain syphilis. It is, in all probability, evidence of irritation due to the biochemical changes in the cerebro-spinal fluid consequent upon products of neuronic decay and possibly of some latent toxin of syphilis upon which the Wassermann reaction depends.

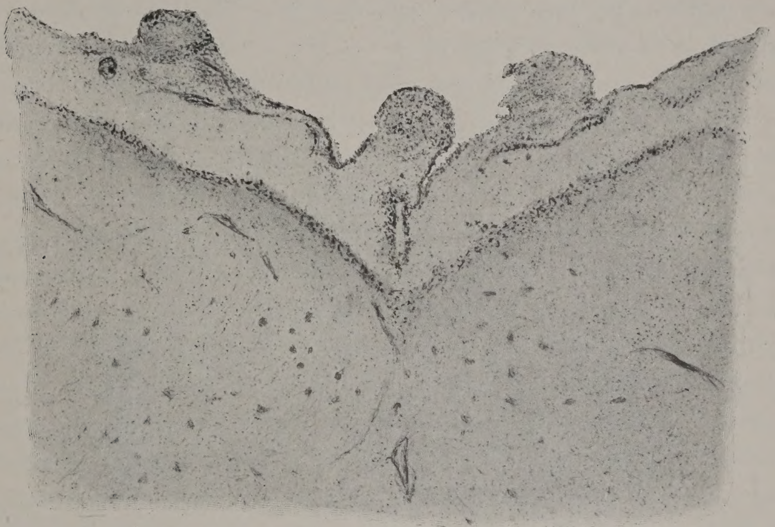


Fig. 27. A section through the floor of the fourth ventricle at the calamus scriptorius, exhibiting the ependymal granulations so characteristic of general paralysis. The small elevations on the surface are seen in vertical section. The whole floor of the ventricle was covered with these granulations, giving it the naked-eye appearance of coarse sand-paper. Magnification 30 diameters.

In tabo-paralysis there is not infrequently obvious grey atrophy of the optic nerves and usually a well-marked naked-eye grey degeneration of the posterior columns.

Microscopic examination. Although the naked-eye appearances together with a positive Wassermann reaction for antibody during life or even post mortem, of the blood and cerebro-spinal fluid would be quite sufficient to establish a correct diagnosis in the great majority of cases, yet it may be necessary to confirm the opinion by microscopic examination. The best method to adopt is to place portions of the cortex from the frontal region in 5 per cent. formol solution for twenty-four hours (even a few hours will suffice if it is an inquest case and time is an object); sections can then be cut by a freezing microtome and stained by Nissl's method and mounted in Canada balsam. More perfect sections can be made by dehydrating with alcohol, imbedding in paraffin and cutting sections with a rocker microtome and staining by Nissl's method or with polychrome-eosin. The following are the points to be looked for in the diagnosis by microscopic examination: (1) The appearance of the vessels; there is an obvious increased vascularity of the cortical grey matter, the vessel walls are changed, and the endothelial cells are swollen and are undergoing proliferation. There is evidence of sprouting and formation of new capillaries; there are many isolated elongated cells which look like collapsed capillaries; these have been termed rod cells (Stäbchenzellen) by Alzheimer. The perivascular space surrounding the vessels of the cortex of the meninges and the cerebral substance are more or less packed with proliferating cells. This *perivascular cell infiltration* is especially characteristic of general paralysis; the cells are of two kinds, viz. lymphocytes and plasma cells; the former consist almost entirely of nucleus with a small surrounding of cytoplasm; the latter are larger and are probably derived from the lymphocytes and are especially characteristic of brain syphilis and general paralysis. The nucleus of the cell resembles the nucleus of the lymphocyte, often showing a wheel-like arrangement with five spokes terminating in five knobs; the cytoplasm exhibits a grumous, amorphous appearance and stains pink with

Plate XX.

Microscopic appearance of the vessels in general paralysis.

A. Transverse section of a small vessel showing (*o*) the lumen; (*end.c.*) endothelial cells, forming the walls; (*l*) lymphocytes; (*pl.c.*) plasma cells.

B. Shows (*o*) the lumen of a small capillary with numerous large (*gl.c.*) neuroglial astrocytes, the branching processes of which form a felt-work around the vessel.

C. Shows a small vessel with proliferation and hyaline swelling of the endothelial cells. (*pl.c.*) a plasma cell.

D. Shows another small vessel with proliferated degenerated endothelial cells (*end. c.*).

E. A larger vessel showing proliferated degenerated endothelial cells (*end.c.*). There is an intense perivascular infiltration with (*l.*) lymphocytes and (*pl.c.*) plasma cells especially the latter. Such appearance of the vessels is very characteristic of general paralysis. (*o*) = lumen of the vessel.

In B the section was stained by Ranke's Victorian blue method; the others are from polychrome methylene blue preparations. Magnification 300 diameters.

To face p. 282.]

PLATE XX.

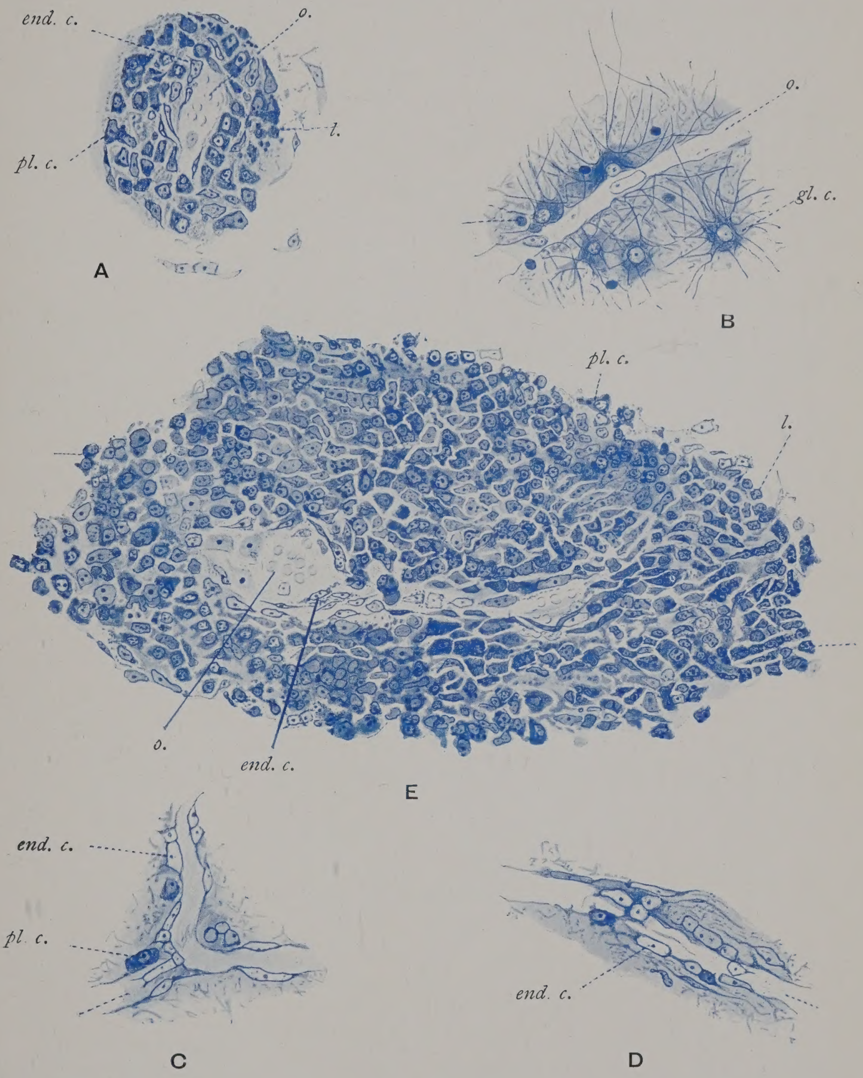

end. c.
o.
l.
pl. c.
A
o.
gl. c.
B
pl. c.
l.
o.
end. c.
E
end. c.
pl. c.
C
end. c.
D

PLATE XXI.

A. Shows the appearance of the neuroglia cells when stained by polychrome blue. There is not only an increase in number but an increase in size. *x*, shows a nucleus dividing.

B. Showing all stages, from the lymphocyte to the plasma cell.

C. The rod-cells of Alzheimer, which are also very characteristic of general paralysis.

D. Shows small vessels with plasma cells (*pl.c.*) around, and hyaline degenerated and proliferating endothelial cells (*end.c.*).

E. Endothelial cells proliferating to form new sprouting capillaries.

Sections stained by the polychrome methylene blue method. Magnification 400 diameters.

To face p. 282.]

PLATE XXI.

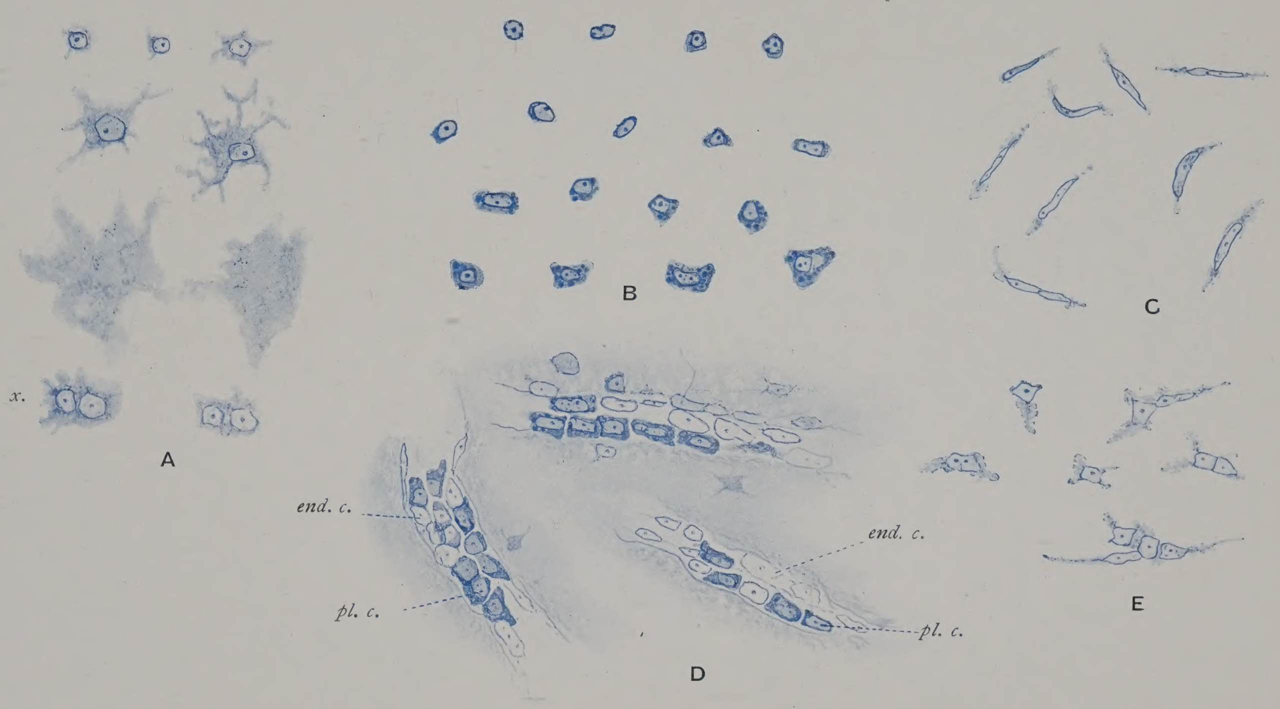

A
x.
B
C
D
E
end. c.
pl. c.
end. c.
pl. c.

Plate XXII.

The glia proliferation of general paralysis.

1. Cortex cerebri, showing the glia cell proliferation and a dense felt-work of the glia fibrils (*b*). Above this is the thickened fibrous pia-arachnoid membrane (*a*), with cell infiltration (*c*). There are numerous dilated vessels (*e*). Magnification 250 diameters.

2. Shows a piece of the cortex more highly magnified, with the large astrocytes (*a*) giving off fibrils in all directions, forming a felt-work at the surface (*b*). Magnification 500 diameters.

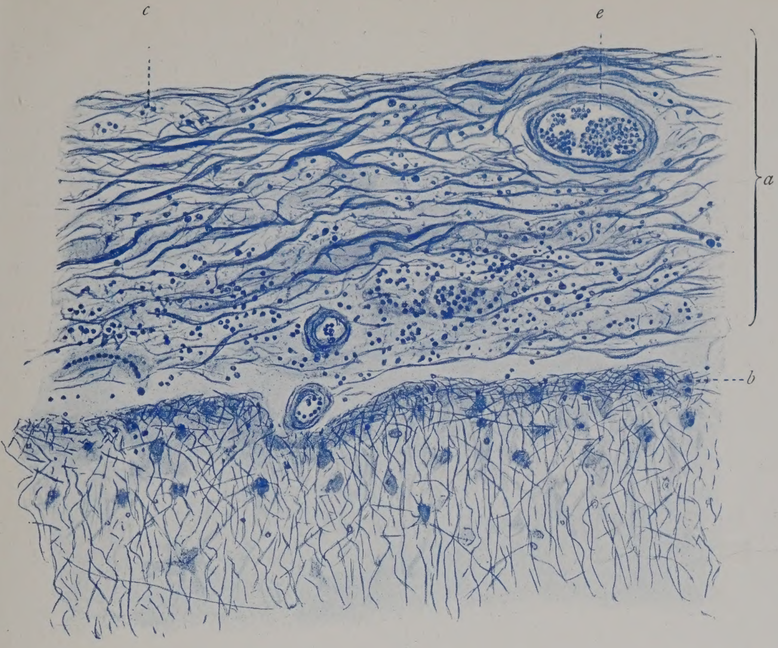
3. Section of the cerebellum, showing proliferation of the glia cells, increase of the vertical fibres of Bergmann, and formation of a marginal border of glia fibrils. *gl. f.*, glia fibrils ; *f. of B.*, fibres of Bergmann ; *gl. c.*, glia cell ; *P.*, cell of Purkinjé ; *gr.*, granule cell. Magnification 250 diameters.

4. Cells of Purkinjé. Magnification 700 diameters.

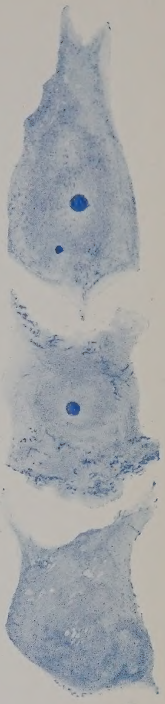
These sections are stained by Ranke's Victorian blue method, prepared by Dr. Rondoni. The advantage of this method is that only the neuroglia is stained.

To face p. 282.]

PLATE XXII.



1



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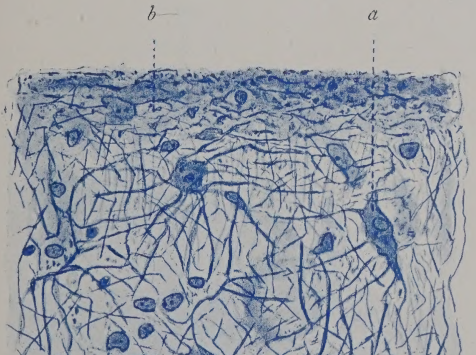
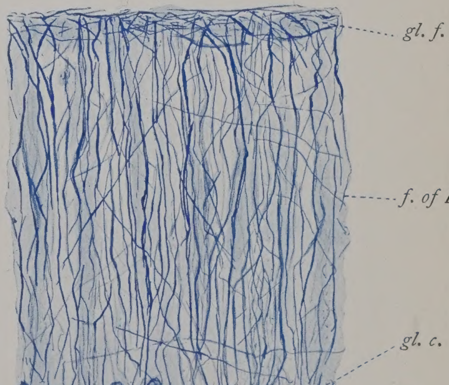


2


gl. f.
f. of B
gl. c.
P
gr.

3

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Plate XXIII.

Sections from the upper part of the ascending frontal convolution :—

A. Normal, showing the different layers of cells for comparison with section.

B. From the same region in general paralysis.

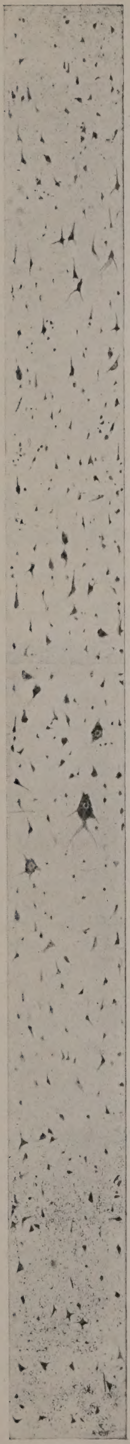
A comparison of the normal with the degenerated cortex shows the following important changes. The number of the pyramidal cells, especially in the more superficial parts, is greatly diminished ; but there is a great abundance of round nuclei, which are the nuclei of neuroglia cells and lymphocytes. The ganglion cells themselves are smaller and their processes are broken off ; they are irregular in shape, and the apical processes, instead of pointing straight up, point in all directions. The large Betz cells are altered in their external appearance, the processes being broken off ; and there is a marked chromatolysis as compared with the normal. A transverse section of a vessel is seen just above the position of these cells, with a marked cell infiltration around it of lymphocytes and plasma cells.

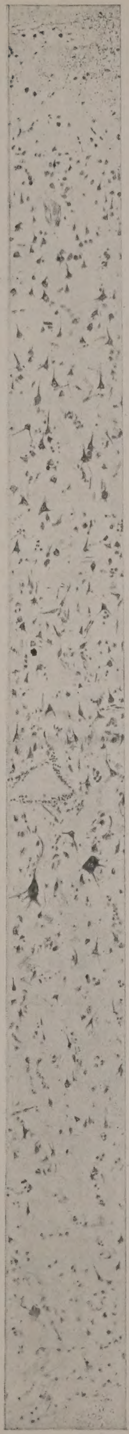
C. Section of the brain in alcoholic polyneuritic psychosis—(pseudo-general paralysis). This was from a typical case of alcoholic dementia with grandiose delusions. It will be observed that the pyramidal cells are not markedly deficient in numbers as compared with the normal ; and that there is no excess of neuroglia nuclei as in the general paralysis section. The peri-nuclear chromatolysis of the psycho-motor cells, characteristic of polyneuritis, cannot be seen owing to the reduction of the drawings.

The sections are stained by Nissl's method.

To face p. 282.]

PLATE XXIII


A


B

C

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eosin. The nucleus is often situated at one end of the polyhedral, oblong, or ovoid cell, and there is frequently a clear halo around it (vide Plates XX and XXI).

(2) *Neuroglia.* Polychrome and eosin-stained specimens will also show remarkably well the proliferation of the neuroglia cells; not only are the neuroglia cells greatly increased in numbers but they are also increased in size: their long branching processes stained pink can be traced on to the small vessels. The nuclei of the neuroglia cells can be recognized by the fine chromatin particles and intranuclear network, in the meshes of which is a clear unstained hyaloplasm (vide Plates XX, XXI and XXII). There is a marked subpial felting of neuroglia fibres.

Rondoni, using Ranke's Victorian blue method of staining, has thus described the changes of the glia in the cerebrum and cerebellum in two cases of juvenile paralysis: 'large spider cells, thick felt-work at the surface of the cortex, tendency of the proliferating glia to increase the limiting surface with formation of foot-like processes towards the vessels - in the cerebrum; increase of the vertical Bergmann's fibres in the cerebellar cortex; formation of a marginal border (not present normally), presence of large astrocytes in the place of many of the cells of Purkinje in the cerebellum.' He also found well-marked perivascular infiltrations in the basal ganglia in one case (Figs. 1, 2, 3, Plate XXII).

(3) *The neurones.* If a normal section of the brain be cut and stained to display the cells it will be observed that there are five layers; most of the cells are pyramidal in shape, arranged in columns with the apical process pointing straight up to the surface, and these processes can be followed some distance.

A section taken from the motor area is represented in the camera lucida drawing stained by Nissl's method; by the side is a drawing from a case of general paralysis and one of Korsakow's disease sometimes termed pseudo-general paralysis (vide Figs. A, B, C, Plate XXIII). It will be observed that the cells in the normal section are in columns; the pyramidal cells are seen with their straight apical processes running up towards the surface; in the general paralytic brain many cells have undergone total destruction, others have an altered shape with processes broken off, the protoplasm crumbling, the nucleus eccentric, and the cells are distorted and displaced; in many the apical processes are like a corkscrew; this is due to the decay and disappearance of the fine dendrites which form the terminals of the apical process (vide Plate XXIV). In the normal brain these dendrites serve as an attachment of the cells to the surface and keep them in position with the apical process straight, but the degenerative atrophy of the dendrites allows the apical process to become slack and the cell to assume various unnatural positions so that the columnar arrangement of the cortical neurones is no longer seen. The number of cells and their shape is not much altered in the pseudo-general paralysis, and this accounts for the fact that the dementia is not progressive and the mind may slowly recover; for the depth of the dementia in insanity is proportional to the destruction of the cortical cell elements.

There is no doubt that in general paralysis the association neurones suffer earliest, most extensively and most severely. The higher association systems, those which have been developed later, phylogenetically and ontogenetically, are the supragranular pyramids, and in general paralysis it is this layer of cells which exhibit most marked evidences of decay. But no portion of the central nervous system may escape in an advanced case; the cells of the basal ganglia, the medulla, the spinal cord, and the cerebellum may show chromolytic and atrophic changes. Rondoni has shown vacuolization of the Purkinje cells of the cerebellum and I have found marked degenerative changes in the cells of the posterior spinal ganglion and the anterior cornua of the spinal cord. Should it be desired to study the microscopic histology of general paralysis more fully, various other methods of fixing, hardening, and staining may be employed. A simple method of showing the neuroglia cell and fibre proliferation is the employment of a solution of Victorian blue by Ranke's method (vide Figs. 1, 2, 3, Plate XXII). Another is to employ the Cajal silver method, which is useful in showing the degeneration of the fibrils in the cells (vide Fig. 28); also for showing the proliferation and hyperplasia of the neuroglia cells. Portions of the brain may be placed directly in Müller's fluid, some pieces being used for Marchi's method to show recent fibre degeneration; others can be used for the Weigert or Weigert-Pal method to exhibit late fibre degeneration and sclerosis. It may be stated that two forms of neuronic degeneration are recognizable in the paralytic brain, one acute and due to vascular changes, the other

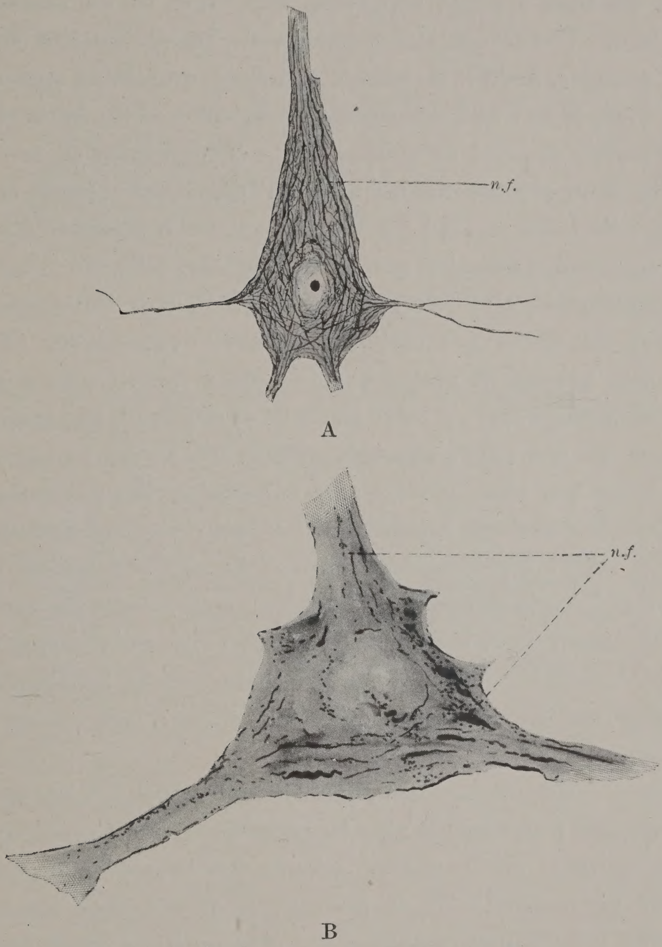


Fig. 28. Two cells stained by the Cajal method: (A) a normal Betz cell showing the neuro-fibrils (*n.f.*) which form the conductile structures that pass from the dendrites through the cell; (B) a Betz cell in general paralysis which has undergone degeneration and decay, and the neuro-fibrils (*n.f.*) are broken up and destroyed. Magnification 500 diameters.

chronic and due to a primary decay; in the former the cells are swollen, the nucleus large and clear, a process of hydration or oedema; it is quite similar to the dropsical appearance seen when all four arteries supplying the brain of an animal are ligatured. The chronic degenerated cells, besides marked chromolytic changes, have a shrunken, distorted, crumbling appearance (vide Plate XXIV and description). Sections of the brain stained by Marchi's method exhibiting acute degeneration of the cells, usually show a large number of recent degenerated fibres stained black. Sections stained by Weigert or Pal's methods show an atrophy of fibres affecting quite early and especially the tangential, the supraradial, and intraradial fibres; in fact the association systems of fibres are earlier and more extensively affected than the projection systems; for unless complications in the form of seizures and vascular stasis have occurred, the projection systems are not much affected. These facts may be correlated with what has already been said concerning the psychology of the dementia and the occurrence of an ataxic paresis rather than paralysis. It is a progressive failure of the highest functions of the mind involving in all cases and from the earliest stage the neurones of association by which percepts and concepts are combined, and by which the fine motor adjustments of the instruments of the mind, viz. the speech organs and the hand, are co-ordinated and controlled.

Course. The disease usually begins insidiously and progresses continuously; the course may be protracted, but in consequence of an epileptic or congestive seizure the disease may become rapidly progressive. There may be such complete remissions that the friends may consider the doctors have erred and the patient should never have been put into an asylum. Often I have seen patients discharged as recovered only to return a few months later with well-marked physical and mental symptoms; their discharge has hastened the progress of the disease, for the hygienic conditions and regular life of the asylum have been changed often to one of excitement, sexual and alcoholic; or worry at the loss of the home and business has been productive of depression and insomnia; there may, too, have been an attempt

PLATE XXIV.

Appearances of the ganglion cells of the cortex in general paralysis.

N.P. A normal pyramidal cell.

(*a.*) Pyramidal cells in various stages of dissolution and decay.

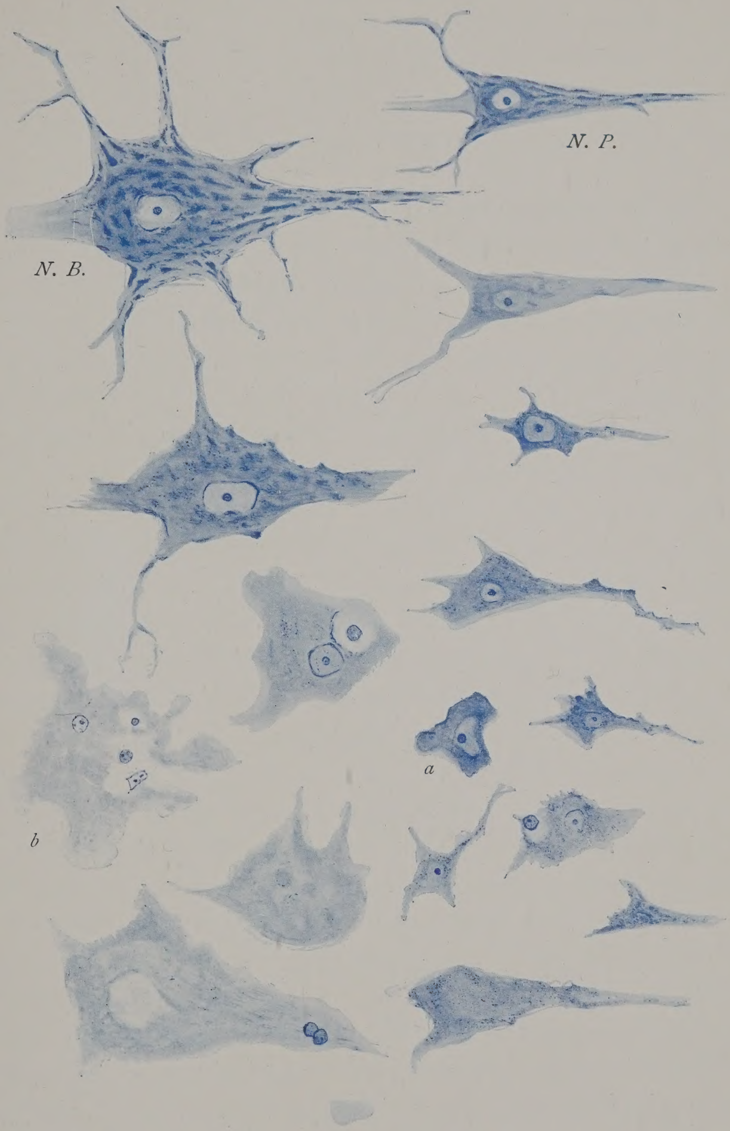
N.B. A normal giant Betz cell from the motor cortex.

(*b.*) Betz cells in various stages of dissolution and decay. It will be observed that the pattern of the Nissl granules, so striking a feature of the normal cells, has completely or almost completely disappeared in the degenerated cells. Another striking feature in the comparison of the normal and degenerated cells is the disappearance of the protoplasmic processes or dendrites. Some of the cells have undergone such a degree of decay as to be hardly recognizable as ganglion cells, and may be spoken of as shadow cells.

The sections were stained by the polychrome methylene blue method. Magnification 650 diameters.

To face p. 286.]

PLATE XXIV.



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to find solace in drink. It is most perplexing to know what to do for the best in many cases; for when the acute symptoms of an early case of general paralysis have passed off, the patient may not have lost the autocritical faculty and is fully aware of the fact that he is in an asylum and that his home is being broken up; he longs to get back to his wife and family and, if his wishes are not granted, suicidal depression or maniacal excitement may follow.

In about two or three years after the prodromal symptoms, the patient is usually quite demented and the speech greatly impaired or even lost. Some cases die within a few months of the onset from the exhaustion of mania or some complication, e.g. pneumonia or tuberculosis; the average time is about two years in men and three years in women, but I have known cases in which the disease has been arrested in the early stage and those who have not had seizures live many years; in two cases out of 100 successive cases that died at Claybury Asylum, twelve years elapsed between certification and death. Rather more than one-half died within a year of admission to the asylum. The demential and tabo-paralytic forms live longer than those with the delirium of grandeur or with marked depression. Death occurs from inanition, bed-sores, cystitis and pyelo-nephritis, croupous pneumonia, inhalation pneumonia, tuberculosis, and institutional dysentery; they may also die in consequence of subdural haemorrhage or in the *status epilepticus*. The juvenile form differs in no essentials from the adult form of the disease. Grandiose delusions are, however, rare, epileptiform seizures are not severe as a rule; the type is more often that of the slow demential form, consequently these cases run a longer course as a rule.

The prognosis is as bad as it can be; occasionally one hears of cases diagnosed as general paralysis which eventually recovered and had no more symptoms; they are very rare and no doubt they were examples of erroneous diagnosis. 'Krafft-Ebing asserts that in 2,500 cases no cure occurred; he cites, however, an observation of Soctlin's in which there is scarcely a doubt of the possibility of a cure' (Oppenheim). The earlier the patient comes under medical supervision probably the better will be the prognosis as regards duration of life; for if a patient be allowed to remain long in a state of restlessness, insomnia, and mental excitement, the disease is much more likely to progress rapidly.

Treatment. The treatment of true general paralysis as distinguished from pseudo-paralysis is most unsatisfactory. The fact that mercury and iodide of potassium, so useful in all forms of syphilitic disease, are practically useless in this disease, is an argument against its being quaternary syphilis and in favour of the view maintained in this work that it is a primary parenchymatous degeneration. Not only have I never seen any good result from antisyphilitic treatment in general paralysis, but I agree with Raymond, Dupré and others, who think that it may do harm. Still if any doubt exists in the mind of the practitioner as to the diagnosis, it is always desirable to try the effect of mercury and iodide, and if after three or four weeks there are no signs of improvement it may be left off. The cases which have apparently benefited were probably cases of pseudo-paralysis syphilitica, or cases of paralysis in which an arrest of the disease would have occurred had mercury and iodide not been administered, owing to the fact that the disease having been diagnosed the mode of life of the patient had been controlled simultaneously with the antisyphilitic treatment.

I have often seen patients admitted to the asylum in a state of acute mania and in whom it was thought the disease would run an acute course; no special therapeutic treatment was adopted and the symptoms underwent arrest and the patient had so far recovered as to be discharged, or the patient had recovered from the state of acute mania somewhat demented, and for a long time, even years, the disease remained in a stationary state; now had mercury and iodide or any of the other agents to which cures have been attributed been applied in these cases, the *post hoc ergo propter hoc* argument would have been advanced. Owing to the successful treatment of sleeping sickness and other trypanosomic affections in animals by injection of atoxyl and soamin, these drugs have been tried in general paralysis by various authorities. I have tried atoxyl in tabes and general paralysis and I have observed no benefit therefrom; the continued treatment by these arsenical preparations is not free from danger as optic atrophy has been known to follow their use.

Those who have had much to do with this terrible malady know how helpless we are at present in its treatment. The most that can be done is to place the patient under suitable care, either in an asylum, in a home for single care, or with attendants in his own home. In deciding the mode of procedure when the case is diagnosed, the doctor must necessarily take into consideration the condition of the patient, the form which the disease has taken, the feelings and wishes of the friends, and especially pecuniary circumstances. There are some cases of general paralysis in which the paralytic symptoms are marked, accompanied by a mild progressive dementia but without episodic symptoms, e.g. delusions, motile restlessness, and seizures, and for a time, provided that such patients are under proper supervision, they may be kept out of an asylum. When, however, the patient has delusions, when he is taking to drinking and otherwise becoming antisocial, the sooner he is certified and placed in an asylum the better it will be for himself and his friends. The mechanical restraint of the padded room of an asylum is infinitely better than the chemical restraint of drugs so often necessary in a nursing home or private house.

There are many accidents and complications to be avoided in the treatment of this disease. Although restlessness and sleeplessness may require drugs in the acute stage yet their continuance is to be deprecated. The continuous employment of sulphonal is most injurious; it aggravates the disease by its pernicious influence on the blood; to subdue or modify the acute and dangerous maniacal excitement of the first stage, sulphonal, or better trional, in 15–30-gr. doses three times a day till the patient is under the influence of the drug, then diminishing the dose, is a frequent practice in asylums, and it is claimed by Clouston that this practice is attended with good results. Sometimes paraldehyde in 2-drachm doses disguised with Ext. Glycyrrhiz liq. ʒss. Syr. Aurantii ʒss. Sp. Chlorof. ♏xv. Aquam ad ℥ij. repeated every four to six hours until sleep is obtained is useful. Under certain circumstances $\frac{1}{100}$ gr. of hyoscine may be given hypodermically when other measures are either unavailing or impossible. The patient should if possible be kept in bed. Paralytics require most care when they become bedridden and when they are suffering from epileptiform seizures. No attempt should be made to feed the patients while they are unconscious. I have seen many times post-mortem fluid nourishment in the bronchial tubes, and this is a fruitful cause of broncho-pneumonia; in the epileptiform seizures it is better to give enemata first to clear the bowel, which is often loaded with scybalous masses, and which may indeed have been the exciting cause of the seizures; secondly, to allow a certain amount of water to be absorbed, and this will be beneficial, for the patients are losing a large quantity of water by the skin as they often perspire freely and there is a considerable degree of pyrexia. The temperature may be raised three or four degrees or more. If the fits still persist 20 grs. of bromide and 20 of chloral may be administered per rectum and repeated if necessary, or if the fits still continue chloroform may be administered until the spasms cease; should there be signs of heart failure it may be necessary to inject alcohol and ether.

Great care should be taken to see that demented patients or patients suffering from seizures have not a full bladder; if necessary a sterilized catheter should be passed. This warning seems hardly necessary, but I have seen a demented paralytic fall out of bed in a seizure and rupture his distended bladder. Patients not infrequently suffer with cystitis from residual urine; for the treatment vide pp. 475, 476. Again, when the patients pass into the late stages of dementia they are apt to choke themselves, a bone may stick in their throat, a large piece of unmasticated tough meat may pass the fauces and become lodged and unless promptly removed cause death from suffocation. Consequently it is necessary to place these patients on minced food. One of the great difficulties in the care of paralytics is the prevention of bed-sores; this can be done by taking great care to keep the patient clean by changing soiled clothes and daily ablutions: still in spite of the care of skilled nurses and attendants bed-sores will arise on parts subjected to pressure, and these must be treated on the general principles laid down on p. 474. It is said that paralytics have brittle ribs and that haematoma of the ear occurs spontaneously; there is no doubt that the ribs of these patients snap more easily than the ribs of normal individuals, and that blood effuses into the cartilages of the ear more readily, so that an occasional case of broken ribs or haematoma may be explained by accidental falls or injuries; but when a number of cases occur these conditions may be properly followed by the dismissal of the charge attendant, as they are evidences of either cruelty or carelessness.

I have observed that the mouths of general paralytics are very foul, and there may be stomatitis and pyorrhoea alveolaris, for which one of the mouth-washes recommended on p. 462 may be used with advantage. In conclusion, it is my opinion that all paralytics should receive twice a week a purgative of some kind, for I am convinced that one of the most fruitful causes of congestive and epileptiform seizures is a loaded bowel causing portal congestion and faecal intoxication.

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* This admirable monograph may be consulted with advantage by all who are interested in the study of the morbid anatomy of general paralysis and syphilitic brain disease; moreover, it contains a very full bibliography of the subject.

CHAPTER IX

DIAGNOSIS OF SYPHILIS OF THE CENTRAL NERVOUS SYSTEM

Brain affections will be considered first, although it will be gathered from previous remarks that when the syphilitic virus attacks the central nervous system it tends to involve the whole cerebro-spinal axis, especially when the affection is a gummatous meningitis. But just as there may be universal and localised syphilides of the skin so there may be universal and localised gummatous infiltrations of the membranes covering the cerebro-spinal axis, or rather there may be some cases in which the virus has especially attacked the blood-vessels and membranes of the brain, while there are other cases in which the spinal cord and its roots are especially the seat of the neoplastic formation. Pathologically, and to a certain extent clinically, they are all one disease, but for convenience' sake they may be separated into two great groups, one in which the brain symptoms are predominant and obtrusive, and the other in which phenomena of spinal affection form the main, if not the sole symptoms. But very often, indeed, a case may present simultaneously cerebral and spinal symptoms or commence with one, the other being superadded. These remarks also apply to parasyphilitic affections and I have given reasons why perhaps it would be better to speak of one tabes and three varieties, viz. cerebral, spinal, and optic ; yet for convenience in formulating a differential diagnosis it is better at present to consider them separately, or at any rate to consider a spinal and cerebral form ; especially is this useful in discussing a differential diagnosis, because what we really wish to find out when a man presents himself with cerebral symptoms is : are his symptoms due to syphilis, acquired or inherited ? or to some other cause. In one case we consider all the other diseases which might produce similar symptoms of functional or organic brain disease; in the other all the other diseases which might produce similar symptoms of functional or organic disease of the spinal axis including the medulla oblongata.

Differential Diagnosis of Syphilitic and Parasyphilitic Brain Affections

Although syphilis is directly or indirectly responsible for a large number of organic diseases of the nervous system and it is a useful practice based upon the results of experience to treat a large number of cases of disease of the nervous system by antisyphilitic remedies, yet it is well to bear in mind that in such a widespread disease as syphilis, *coincidence* as well as *cause* is of very frequent occurrence. Therefore, in making a diagnosis we have to determine the question whether the fact that the patient has had syphilis, or even presents at the time of examination signs of active syphilitic lesions, is a coincidence or bears a direct or indirect causal relationship to the nervous symptoms for which he is consulting you. In many cases, especially in women, there may be no history of syphilitic infection and no signs on the body, and yet the character of the disease may clearly point to the possibility or even the certainty that it is of syphilitic origin; or it may happen that without a history or signs of syphilis a nervous affection may arise in an individual, which after antisyphilitic treatment ends by cure, arrest, or amelioration, but it does not necessarily follow that the disease was syphilitic, for we do not know what would have happened in the way of improvement if no drugs had been administered; in fact we cannot be sure whether it was an example of *coincidence* or *cause*. Seeing that syphilis may attack any part of the cerebro-spinal nervous system, causing general or local irritation or destructive effects, the symptom complex may resemble almost any disease of the nervous system. The diseases which might be mistaken for syphilitic brain disease are (1) neurasthenia and hysteria, (2) arterio-sclerosis, (3) chronic alcoholism especially in the subject of antecedent syphilis, (4) polyneuritic psychosis (Korsakow's disease), (5) dementia praecox, (6) epilepsy with dementia, (7) lead-poisoning, (8) tubercular and other forms of meningitis, (9) disseminated sclerosis and sclerosis the result of softening, (10) new growths, primary and secondary, (11) cerebral abscess, (12) general paralysis. In many instances the patient may be the subject of obvious acquired or inherited syphilis, or a history of syphilis is readily obtained or may be suspected.

A person suffering with an affection of the nervous system, whose blood gives a positive serum reaction, is much more likely to be suffering from a syphilitic affection than one who has had syphilis but whose blood does not yield the reaction ; for it is an indication that the syphilitic virus is still active, and therefore capable of producing true syphilitic lesions of the nervous system. An examination of the cerebro-spinal fluid in such a case will afford most valuable evidence not only as to whether the disease of the nervous system is post-syphilitic or not, but whether it is one of true syphilitic inflammation or of a degenerative parasyphilitic nature. *Such evidence is of vital importance*, for, in the case of the former, mercury, rapidly but judiciously administered, may be followed by a complete cure, whereas in the latter it will do more harm than good (vide Case 35, p. 167).

It is of the greatest importance, therefore, to be able to decide whether such a syphilitic patient is suffering from the immediate effects of the syphilitic virus on the enclosing, supporting, and vascular structures with secondary effects on the nervous structures, or from the remote effects of the syphilitic poison upon the biochemical stability, and, therefore, durability of the nervous elements themselves. In the former case the nervous elements are secondarily irritated, damaged, or destroyed at random, although, for anatomical reasons, there are certain seats of election, the onset is more or less sudden, the symptoms are obtrusive and contrast markedly with parasyphilis, in which the onset is insidious, progressive, and of slow evolution. We shall see that examination of the blood and the cerebro-spinal fluid will often enable a decision to be arrived at as to which group of post-syphilitic affections the patient is suffering from. The sooner the nervous affection follows the primary infection the more likely it is to be syphilis of the nervous system ; the longer the interval the more likely it is to be parasyphilis, but exceptions occur, especially to the former rule. According to the statistics of Fournier two-thirds of the cases of cerebral syphilis occur in the first six years of the disease; while in general paralysis about two-thirds of the cases occur between the sixth and twelfth years. Indeed four-fifths of the cases occur from the sixth to the fifteenth years with a maximum for the tenth. The earliest appearance is in the course of the third year. It is much more common for tertiary syphilitic lesions of the nervous system to arise very long after the primary infection than for tabes dorsalis or general paralysis to occur within a few years of infection. There is no period from the appearance of the primary sore onwards to the end of life in which true syphilitic lesions of the nervous system may not occur.

The first point to decide is whether the nervous symptoms from which the patient is suffering are the direct result of the syphilitic virus upon the membranes, the blood-vessels and their sheaths, with secondary degeneration of the nervous elements for example, (1) gummatous meningitis—cerebral, cerebro-spinal, spinal; (2) localised gummata, single or multiple, obliterative arteritis, or are the symptoms those of tabes or general paralysis? It is not always easy to decide, but it is well to bear in mind that the shorter the period which has elapsed between the primary infection and the onset of the symptoms the more likely it is to be due to the action of the syphilitic virus; it is very unusual for a generalized syphilitic meningitis to commence after the lapse of five years from primary infection; quite one-half of the cases manifest symptoms within the first eighteen months, in some the symptoms are obvious with the appearance of the roseolar rash, and a few cases have occurred when the primary sore was yet unhealed. A very different order of things to tabes dorsalis and general paralysis, for in these diseases it is very rarely that symptoms occur in less than four years after infection, and the average time is ten years.

In the case of active syphilitic meningitis, arteritis, and gummata, all of which conditions may occur simultaneously, successively, or progressively over the whole cerebro-spinal axis, the blood will most probably give a positive serum reaction, the cerebro-spinal fluid will exhibit a great increase of lymphocytes and albumen, but it may give neither antigen nor antibody reaction. The administration of mercury will cause the disappearance of the serum reaction, the disappearance of the lymphocytes from the cerebro-spinal fluid, and the cure, amelioration, or arrest of the symptoms if the disease has not been allowed to progress so far as to lead to thrombosis of vessels and destructive ischaemic softening of the cerebro-spinal nervous substance. In the case of parasyphilis, especially general paralysis, both the blood serum and the cerebro-spinal fluid give the Wassermann reaction; the cerebro-spinal fluid both in tabes and general paralysis exhibits lymphocytosis and shows the presence of albumen.

CEREBRAL SYPHILIS

Pseudo-general paralysis (diffuse syphilitic brain disease) is sometimes termed syphilitic general paralysis. I think that this is an unfortunate term to use, because general paralysis is of syphilitic origin and yet is incurable by antisyphilitic remedies. Diffuse syphilitic brain disease is not a primary neuronic decay, but a widespread chronic inflammatory process affecting the enclosing, supporting and nutrient structures, due directly to the action of the syphilitic virus; instead of occurring, as a rule, many years after infection, the most serious cases commence within the first four years after infection, therefore the average age incidence is at least six years below that of general paralysis.

The early diagnosis of *diffuse cerebral syphilis* is of the most vital importance, for it is amenable to antisyphilitic treatment, which if adopted in its early stages arrests or ameliorates, but occasionally a partial cure, or even a cure may be hoped for. It is, therefore, essential to know what are the diagnostic differences of general paralysis and diffuse cerebral syphilis. It is rarely that true general paralysis is associated with permanent coarse obtrusive paralyses; in fact the term 'paresis' expresses the condition more truly. On the other hand, diffuse syphilitic brain disease is very liable to be followed by paralyses of all kinds.

Still, cases of universal syphilitic *endarteritis cerebri* accompanied sometimes by a gummatous meningitis and gummatous cerebral tumours for some time present no evidence of coarse paralyses, and not infrequently such cases are admitted to the asylums and are more often than not diagnosed as general paralytics (see Figs. 1, 2, pp. 58, 59); accordingly they are not treated with mercury. At the autopsy one recognizes a disease which is of a totally different pathological nature; the brain is not wasted, the convolutions are not shrunken, if anything they are rather flattened, as if there had been an excess of intracranial pressure. The patient has been undoubtedly demented, and, although there were no signs of paralysis, he was weak, shaky, and tottery in gait. But was the mental condition like that of a typical paralytic dement? had he no physical signs or subjective symptoms during life which would point to his suffering from diffuse cerebral syphilis? These have been the questions I have many times asked myself when making autopsies on such cases. First of all many of these patients have signs of syphilitic skin lesions, often scars of gummata. The friends will tell you that they have for some time complained of severe headache, often worse at night. If accompanying the dementia they have had coarse paralyses, blindness or other obtrusive symptoms, coming on more or less suddenly, and with remissions and regressions, there is but little difficulty in diagnosis; but where the symptoms are mainly demential the diagnosis is not so easy, and necessitates a comparative knowledge of this form of dementia and the dementia characteristic of general paralysis. I now attempt to indicate the main points which will enable a differential diagnosis to be made. The dementia of syphilitic brain disease is partial; it is unequal and elective in its attack; it compromises certain forms of psychic activity, memory, association of ideas, energy and capacity for mental work, rather than diminishing intelligence as a whole. It does not alter so profoundly the character and personality of the individual, nor in the great majority of cases does it destroy the patient's idea of his past and present state, nor that of orientation in time and space. He still possesses the *autocritical* faculty, and is more or less conscious and disturbed by his mental deficiency. It is not necessary to inquire of others whether he has had lapses of consciousness or signs of torpor and apathy, or fits of depression, for he himself will usually tell you.

From a clinical point of view syphilitic dementia is accompanied by numerous mental and bodily symptoms. The mental symptoms comprise states of excitement and depression more sudden and accentuated than general paralysis; there are disturbances of consciousness in the form of somnolent, drowsy, semi-comatose conditions from which the patients emerge, again to relapse, and such remissions are especially significant. In the intervals there are not the same intellectual and affective deficiencies as in general paresis, nor do the same approbativeness, moral optimism, suggestibility, mobility, and automatism obtain as in general paralysis. The accompanying bodily troubles are coarse and obtrusive, and due to focal disseminated lesions in the brain and spinal cord, causing apoplectic and epileptiform seizures, followed by aphasia, paraphasia, apraxia, hemiplegia, monoplegia, paraplegia, triplegia due to affection of cortical centres and their projection systems: or paralyses and sensory-troubles from affection of cranial nerves and their nuclei of origin arise. The clinical picture may be slow in its evolution; it is irregular, variable, and proceeds by fits and starts, with prolonged and sometimes indefinite periods of arrest. It is often a stationary dementia, and under the influence of mercurial treatment it may undergo regression. True general paralysis may occasionally—but rarely, according to my experience—supervene in such cases of regressive or arrested cerebral syphilis. I was asked recently to see a case of old syphilitic hemiplegia which had been in the asylum three years; he was regarded as a case of arrested general paralysis. There was a history of syphilitic right-sided hemiplegia for which he had been treated at the National Hospital; it was alcohol brought him to the asylum. He was diagnosed on admission as general paralysis on account of unequal pupils and slurred speech. I examined him and found Babinski's sign on both sides, also ankle clonus and some spasticity in the limbs and paresis of the right arm and hand. The left pupil was dilated, and reacted only sluggishly to light, but reacted to accommodation.

The right pupil reacted both to light and accommodation. The autocritical faculty was good; there was a little elation; but little or no dementia; his orientation was good both in time and space. Lumbar puncture was performed and the cerebro-spinal fluid did not give the Wassermann reaction; consequently neither clinically nor pathologically could this patient be considered to be a general paralytic. The syphilitic dementia may be accompanied in rare instances by a tabes dorsalis, and we may think we have a case of tabo-paralysis, or there may be a pseudo-tabes associated with pseudo-general paralysis.

When hereditary syphilis produces in a child or young adult a diffuse meningo-encephalitis, it may simulate general paralysis (vide p. 437).

The best criterion lies in the mode of evolution of the dementia and paralysis. The evolution of general paralysis is slow, insidious, and progressive towards marasmus and death. Syphilitic dementia, especially if it be treated, remains stationary or tends to regression, ending in a state of acquired infantile dementia, to which the history affords the clue. In my experience dementia from congenital syphilis is much less frequently met with than juvenile general paralytic dementia.

Recent investigations have shown that tuberculosis may produce in children diffuse encephalic changes of a chronic inflammatory and hyperplastic nature, terminating in a diffuse nodular sclerosis of the brain. These lesions cause mental enfeeblement, imbecility, and idiocy.

CEREBRO-SPINAL AND BASIC MENINGITIS

This form of syphilitic affection of the nervous system has already been considered under spinal meningitis, for the two conditions are inseparable.

Headache severe and paroxysmal, often worse at night. In the more common basic form the pain is referred to the frontal, parietal, and temporal regions and is deep seated and cannot be definitely localised; it may spread later on to the occipital region, the neck and the spine, there may be neuralgia of the fifth; sometimes the pain is referred to the back of the eye.

In this form of the disease the pain is not usually influenced by pressure, and there is not the same definite local tenderness as when the convexity is affected. There are few cases of meningitis in which headache is not an early and pronounced symptom ; it is not unfrequently accompanied by vomiting. The patient is subject to attacks of vertigo, reeling, and loss of balance. It is pretty generally recognized that syphilitic meningitis differs from other forms of meningitis, e.g. tubercular, pneumonic, pyogenic and cerebro-spinal meningitis, by the absence of pyrexia. The *temperature* is usually *normal* or even subnormal, and if pyrexia be present it is usually of an anomalous form.

Affections of the cranial nerves are common and particularly of the *optic nerves and chiasma*, causing neuritis and later post-neuritic atrophy. The nerves supplying the muscles of the eyeball are frequently affected, causing *ophthalmoplegia and ptosis.* Basal meningitis frequently gives rise to *polydipsia, polyuria*, and *glycosuria* occasionally occurs. Disturbances of consciousness play a most important rôle in the symptomatology of basic syphilitic meningitis, and *drowsy stupor* may be quite an early symptom. The psychical symptoms have been already described above.

The general symptoms of meningitis of the convexity may be vomiting, stupor, giddiness, and psychical disturbances. If, however, it is a circumscribed gummatous pachymeningitis or meningitis (vide Case 15, p. 87) there is tenderness over a definite spot on percussion or deep pressure, and if the disease is localised to some definite area, the irritation or destruction of which causes characteristic functional affections, there may be little or no difficulty in diagnosis. The difficulty arises when it is situated in the association centres, the damage of which may cause no obvious symptoms ; in such case a ‘ silent ’ part of the brain being affected, headache for a long time may constitute the sole symptom. But headache and tenderness on pressure in the subject of syphilis or suspected syphilis often disappears in a remarkable manner under the influence of active and vigorous antisyphilitic treatment, thus confirming the diagnosis.

HYSTERIA AND HYSTERO-EPILEPSY

Hysterical paralysis and hystero-epilepsy, according to Lang and Fournier, sometimes occur in the secondary stage of syphilis, and the symptoms disappear under antisyphilitic treatment.

Such cases might give a positive Wassermann serum reaction, but inasmuch as there is no organic disease of the nervous system, it is probable that the cerebro-spinal fluid would give a negative result and would not show a lymphocyte reaction or the Noguchi test.

Patients who have had syphilis often develop hysteria and hypochondriasis, and not very infrequently syphilophobia and fixed systematized delusions, and the above-mentioned tests could be employed and possibly the negative reaction would serve to allay their ungrounded fears. One must, however, be always on one's guard lest there is an element of reality in these cases; e.g. a patient was under my care for brain meningitis, from which he made a good recovery. He came to me a year later with a slight pain in the left side; beyond that, he had nothing pointing to cord disease. I told him that I hoped it was nothing more than muscular pain, but he was to come and see me again if he was not better. A week later I was asked to see him by a practitioner who regarded his case as functional. He was paralysed in the lower extremities; it had come on somewhat suddenly. Knowing the history of the patient, I took him into the hospital, and for the first few days he rapidly became worse and lost complete control over the bladder and rectum as well as complete loss of sensibility below the level of the seventh rib. Under antisyphilitic treatment he made a complete recovery.

NEURASTHENIA

A neurasthenic who has had syphilis, and who is suffering with irritability of temper, headache, insomnia, lassitude, loss of memory, who has occasionally difficulty in finding words to express his thoughts, complaining of migrainous or vertiginous attacks and of various cutaneous sensory disturbances, in the form of anaesthesia or paraesthesia, who is hypochondriacal and depressed, who has a mortal dread of softening of the brain, from which some friend of like habits and history has suffered, whose knee-jerks are exaggerated, and whose physiognomy exhibits a wearied, hypotonic, anxious condition, with lack-lustre eyes, will naturally arouse in the mind of the practitioner the possibility of the patient being in the prodromal stage of general paralysis. Examination of the pupils and of the cerebro-spinal fluid with negative results, in conjunction with the absence of any signs of dementia, will usually enable him to decide in favour of neurasthenia and to give a favourable prognosis.

ARTERIO-SCLEROSIS

Syphilis is probably the most important factor in the production of arterio-sclerosis, especially cerebral arterio-sclerosis. Consequently a patient who has had syphilis may present signs of general arterio-sclerosis in which the vessels of the body generally, and of the brain and kidneys in particular, may suffer. Toxic conditions of the blood may arise in consequence of the latter affection; owing to the renal inadequacy, and probably also the diseased conditions of the vessels of the brain, uraemic symptoms may arise in a person who is suffering with mental symptoms caused by the disease of the cerebral vessels and the altered conditions of the blood. The symptoms of uraemia—namely, headache, pyrexia, twitchings, epileptiform seizures—may simulate the symptoms and seizures of general paralysis. There are, however, points of difference which will enable a diagnosis to be made. In such a case examination of the heart and arteries and of the urine would afford information. The pupils in uraemia may have a sluggish reaction to light, but they are rarely unequal or irregular. Very probably examination of the fundus will show retinitis, haemorrhages, and arterio-sclerosis of the retinal arteries, causing thickening of the walls, which appear like silver wires; consequently the veins as they pass over the thickened arteries often show a kink. The patient is usually over 50 years of age. The cerebral symptoms are often characterized by a progressive dementia and paralysis, but there are many points of difference, both in the mental and motor symptoms. From the psychological point of view, the dementia of cerebral arterio-sclerosis is a partial, unequal loss of mind. The patient becomes irritable, suspicious, and even dangerous to himself and others; there is exaggeration of emotivity, and various psychopathic reactions complicate the intellectual decadence; but, unlike general paralysis, the patient retains his notions of personality and the faculty of autocriticism, and is therefore more or less conscious of his loss of memory and mental enfeeblement. From a clinical and evolutional point of view the dementia of arterio-sclerosis is associated with varied and innumerable paralytic symptoms appearing after seizures or in sudden attacks, due to the capricious and random affection of the different arteries of the brain supplying different functional territories. The arteries may be so thickened as to interfere with a proper supply of blood to various areas of the brain, or they may become occluded by thrombosis, in which case disseminated areas or foci of inflammatory softening and necrosis may result. The symptoms naturally vary according to the seat and extent of the lesions. When the anterior cerebral artery is affected a seizure may occur, and, owing to the paracentral lobule being destroyed on one or both sides, a leg monoplegia or paraplegia may result accompanied by disturbance of spontaneous psychic activity and of memory; in affection of the middle cerebral, there results hemiplegia, aphasia, apraxia, paraphasia, word-deafness, word-blindness and dysarthria; in the posterior cerebral, hemianopsy, psychical blindness, and disturbances of topographic orientation (vide Plates IX and X, Figs. A, B, C). If symmetrical areas are affected by arterial ischaemia, or the projection fibres proceeding from those areas in the internal capsule undergo necrotic softening, paralyses of a pseudo-bulbar nature—for example, dysarthria and difficulty of swallowing, &c.—may occur. One fact obtains in all cases: it is a parallelism between the depth of the dementia and the extent and degree of destruction of the cerebral cortex. Besides, we may have other less serious bodily disturbances resulting from arterio-sclerosis of the cerebral vessels which might especially be thought to indicate general paralysis—namely, apoplectic attacks followed by hemiparesis, dysarthria, difficulty in swallowing, disorders of psycho-reflex activity of speech, or mimicry, forms of apraxia and asymboly combined more or less with pareto-spastic symptoms. The character of the physiognomy in the case of organic dementia differs from that of general paralysis by the predominance of mimic disturbance over intellectual deficiency. In the former disease the patient shows a marked emotivity, readily bursting into tears or laughter, and not infrequently there is facial asymmetry of spasmodic or paralytic origin. These cases of arterio-sclerosis producing progressive dementia, paresis, or paralysis, and pseudo-bulbar speech troubles are sometimes erroneously diagnosed as general paralysis of the insane, especially when accompanied by seizures, mental excitement, or depression and delusions. I have, however, seen typical general paralysis accompanied by general arterio-sclerosis ; but, as a rule, the cerebral arteries in general paralysis are not thickened, and examination of the fundus rarely shows any noteworthy changes unless it be a case of tabo-paralysis, when optic atrophy is very frequently discovered. In a number of cases which I have examined of arterio-sclerosis I have found multiple softenings in the internal capsule and basal ganglia caused by disease of the lenticulo-striate arteries. These lesions account for the emotivity, mimic disturbances, dysarthrias, and pseudo-bulbar affections.

Chronic Alcoholism

Cases of chronic alcoholism in which there is a history or signs of syphilis frequently offer many difficulties in the matter of diagnosis. They do so for many reasons : first, because many paralytics in the early stages of the disease take to drink. The symptoms they present are largely due to the effects of the intoxicant, and they are certified and sent to the asylum, where the diagnosis of *mania a potu* is made. The true nature of such a case declares itself after the effects of the alcohol have had time to wear off. I once saw a man who upon admission saw black devils come and perch on his nose and fill his nostrils with stinking things. He had been drinking heavily. A week later, when the effects of the alcohol had passed off, he had a marked euphoria. and when asked whether he still saw black devils that came and perched on his nose he said that they were angels with wings of gold, and that they put sweet perfumes in his nostrils.

Hallucinations, especially of vision and of a terrifying nature, are common in alcoholism; they are not common in general paralysis uncomplicated by alcoholic intoxication. The dementia of alcoholism is characterized by the predominance of the moral affective defects over the intellectual, by a degradation of the ethical sense, deterioration of will, and the tendency to delusions of persecution, jealous suspicion, and violent motor reactions, rendering them dangerous to themselves and others. The psychic activity is confused rather than destroyed. There is deficiency rather than absence of memory.

Polyneuritic Psychosis (Korsakow's Disease)

The clinical picture of a severe case of the disease is not unlike that of general paralysis in its final stages. It is commoner in females than in males. The patient, prostrate, bedridden, and emaciated, with contracted limbs and suffering with bed-sores, lies oblivious to her surroundings; roused to reply to questions, only incoherent responses are obtained. Such a condition may well be termed *pseudo-general paralysis.* Frequently a definite diagnosis cannot be made unless the case be watched; if this be done occasionally at intervals the mind may appear to be relatively clear in Korsakow's disease. The definite signs and symptoms of polyneuritis may be present. When the symptoms of Korsakow's disease are confined to loss of memory and mental confusion the diagnosis is more difficult. Autocriticism may still be present in a patient suffering with Korsakow's disease; consequently, when confronted by her mental shortcomings she betrays astonishment and even alarm in her facial expression. The general paralytic, having lost the faculty of *autocriticism*, is self-satisfied, and the expression is one of foolish contentment or of apathetic indifference. Both diseases are characterized by *pseudo-reminiscence*; but in general paralysis there is fantastic fabulation, whereas in Korsakow's disease the content of the pseudo-reminiscence is more or less of a probable nature and usually related to some past experiences in the patient's life. For example, a woman suffering with alcoholic dementia, named Gloster, was certified as suffering from delusions of grandeur. 'She said she was the Duchess of Gloster.' After she had been in the asylum some time and the dementia was passing off, I questioned her in reference to the delusion in the certificate. She stated: 'My husband was humpbacked; his name was Gloster, and his pals called him the Duke of Gloster. If he was the duke, surely I had a right to call myself the duchess.' She admitted that it was foolish on her part to have done so. A very characteristic delusion of this disease is that there is a baby in the bed. In Korsakow's disease there is complete disorientation; the patient has no idea of time or place or of the identity of persons. In general paralysis, on the other hand, there is incomplete disorientation; the patient still recognizes familiar surroundings and persons with whom she is habitually brought in contact. The loss of memory and receptivity is transient or temporary, but it is more complete for the time being than in general paralysis; the *amnesia* of general paralysis may not be so marked at first, but it is progressive and continuous. The existence of the Argyll-Robertson pupil and of irregular, unequal pupils as permanent phenomena would decidedly point to general paralysis rather than Korsakow's disease. The cerebro-spinal fluid in the case of Korsakow's disease would be negative as regards the antibody reaction and lymphocytosis.

In all doubtful cases of chronic alcoholism lumbar puncture should be performed and the cerebro-spinal fluid examined.

DEMENTIA PRAECOX

The age, mode of onset, and evolution of this disease are unlike that of general paralysis, except in the juvenile form. In 80 per cent. of the cases of dementia praecox the mental symptoms occur before the age of 25. There is usually a strong hereditary history of insanity, and no history or signs of congenital syphilis. General paralysis is a disease which on an average does not commence until ten years after infection; therefore the most frequent period for general paralysis to occur is not adolescence, but the prime of life. Occasionally, however, I have seen young women admitted to the asylum with *dementia paralytica* in whom the mental affection commenced at a relatively early age. Inquiry into the history often shows that they were prostitutes or had come from a refuge home, or a history of congenital syphilis was either certain or probable. Dementia is not the earliest sign of this affection, but hallucinations and fragmentary non-systematized delusions; katatonic conditions, negativism, and emotional indifference are leading symptoms; the Argyll-Robertson pupil is not present, the pupils are not unequal, and as a rule not irregular. If there is any doubt, the diagnosis can at once be settled by examination of the blood and cerebro-spinal fluid by the Noguchi and Wassermann methods, and by cyto-diagnosis of the cerebro-spinal fluid. Twenty successive cases of dementia praecox were examined by Drs. Harper, Smith, and Rae Gibson in the laboratory, and in every instance the result was negative.

The following case is a good illustration of the difficulty of diagnosis between syphilitic cerebral arterio-sclerosis and dementia praecox.

Case 40. S. M., aged 23, occupation, a cap-maker, was admitted to Horton Asylum, May, 1903. On admission she is said to have suffered with aural and visual hallucinations and delusions. She complained of such *severe headache* that she felt inclined to do something desperate. There was albuminuria. Six months later she became blind, and retinal haemorrhages were seen, so that she was said to be suffering with chronic Bright's disease. Subsequently the kidney trouble improved, and for five years the notes state that she was childish and imbecile; in addition, her mental state alternated between mild exaltation, in which she was restless, impulsive, and noisy, shouting out obscene expressions, and periods of dull, listless depression, in which she could neither speak nor feed herself. She died at the age of 29, that is, six years after the onset of symptoms. Two months before she died the albuminuria returned, and she had several convulsive seizures. At the autopsy she was found to have recent pericarditis and fibroid kidneys. There was general arterial sclerosis, and one coronary artery was blocked at the orifice. The brain was forwarded to me for examination as that of a case of dementia praecox. I found all the arteries of the circle of Willis and their branches, great and small, affected by a nodular obliterative arterial sclerosis; there were in addition small multiple softenings in the centrum ovale, the corpus callosum, the caudate and lenticular nuclei of the corpora striata, and the anterior halves of the internal capsule on both sides. The corpus callosum was extremely thin, especially the anterior portion, and there was marked dilation of the lateral ventricles. Both optic nerves were extremely atrophied.

Now universal arterial sclerosis occurring in a patient aged 23, even though suffering from Bright's disease, is extremely rare apart from syphilis, and although no mention is made of specific affection in the notes, experience teaches that this in no way excludes the probability of syphilis being the essential cause. This case only shows the great importance of remembering that severe and prolonged headache accompanied by mental symptoms should lead to a careful investigation for signs or history of syphilis; and, even if no history be obtained, the desirability of trying the effects of antisyphilitic remedies. It might be asserted that the albuminuria contra-indicated the administration of mercury, but it is probable that the kidney disease was really syphilitic in origin; in such case mercury instead of doing harm would do good.

Epilepsy with Dementia

A large number of the cases of juvenile general paralysis, especially those patients who are congenital imbeciles and subsequently develop convulsive seizures, are diagnosed as epileptic imbeciles, but the pupillary phenomena, the history or signs of congenital syphilis together with progressive dementia and speech affection should lead to the suspicion of paralytic dementia and a positive serum reaction and lymphocytosis of the cerebro-spinal fluid should confirm the diagnosis.

Epilepsy may occur as a result of an old syphilitic brain disease and it may be indistinguishable from symptomatic epilepsy. The following case is an illustration in point :—

Case 41. W. W., aged 32, male, farm bailiff; married eight years; four children. Contracted syphilis at 13. Treated for two years. Had sore throat and rash. Children all healthy. Habits temperate. Six years ago while at work he had a fit and lost consciousness. *He had previously suffered from loss of memory of words, knowing what things were but he was unable to name them.* After the fit his speech became thick, then he had several more fits, after which he had paresis of the right limbs and his face was slightly drawn. He suffered about this time with headache, which was worse at night. He has now no paralysis or aphasia, but for the last five years he has suffered with fits. Sometimes three or four a day, sometimes only one or two a week.

Description of fit by his wife.—Both cheeks became flushed. He complains of dimness of sight for some hours before. The fits begin by conjugate deviation of the head and eyes to the left. He then makes a gurgling in the throat, followed by tonic spasm in arms and legs. The arms are extended, the fingers clenched in the palm. No clonic spasms follow. He then breathes deeply.

Fournier considers it probable that a symptomatic epilepsy the result of parasyphilis may occur (vide p. 196) independently of any inherent tendency. Moreover, epilepsy, which is a common affection, may, and frequently does, occur in the subjects of syphilis.

The occurrence of partial, unilateral or universal epileptiform convulsions may, as many cases show, be erroneously attributed to symptomatic epilepsy or general paralysis; whereas really they are the result of old syphilitic brain disease with softening in a region near the motor area, but not involving it so as to produce a monoplegia or hemiplegia.

URAEMIA AND LEAD-POISONING

Uraemic fits and the fits due to lead-poisoning may be mistaken for syphilis and general paralysis, but the history, signs, and characters of the disease should enable a diagnosis to be made. The arterial hypertension, albuminuria, casts, retinal changes, and cardiac hypertrophy found in chronic Bright's disease are unusual in syphilis of the nervous system *per se*, and uncommon in general paralysis. Not infrequently, however, syphilis is combined with either chronic Bright's disease or plumbism (vide Case 30, p. 153).

TUBERCULAR AND OTHER FORMS OF MENINGITIS

Tubercular meningitis, although common in young children, is relatively rare in adults. I have not met with a case on the post-mortem table at the asylums, although pulmonary tuberculosis is very common. Tubercular meningitis is acute and progressive. There are usually signs in the lungs of tubercular disease. There is, as a rule, more stiffness and retraction in the neck and muscular rigidity. The patient falls into a stupor, which deepens to coma, and the symptoms are continuous, progressive and as a rule, unlike syphilis, without remissions. The irritative phenomena precede the paralytic phenomena and the pyrexia is more definite and continuous than in syphilitic meningitis.

Calmette's reaction may be employed, but inasmuch as syphilis and tubercle are often combined, a positive reaction would not be so valuable as a negative one. The examination of the blood and cerebro-spinal fluid would help in arriving at a diagnosis, as it also would if it were any other form of meningitis due to the meningo-coccus, pneumo-coccus or pyogenic organisms. In all of these forms the pyrexia would be characteristic and the history and course of the disease would enable a correct judgement to be formed in most cases, but the pathological examination would serve to confirm it. The basic meningitis of infants, especially if there be signs of congenital syphilis or a history pointing to it, might give trouble if a diagnosis were allowed to rest on clinical evidence alone; but in such a case the positive syphilitic reactions of the blood and cerebro-spinal fluid should set all doubts at rest.

Disseminated Sclerosis and other Scleroses the Result of Softening

The typical insular sclerosis of young adults should not be mistaken either for general paralysis or multiple syphilitic brain disease, although cases of multiple focal patches of sclerosis, the result of syphilitic arteritis, thrombosis, and ischaemic softening, in many respects resemble that form of insular sclerosis the cause of which is at present unknown. The difference in the clinical symptoms and the evolution of the disease to general paralysis in most cases suffice for a differential diagnosis ; but if there be any doubt, examination of the cerebro-spinal fluid and blood with negative results will serve to exclude general paralysis. Whereas nystagmus is not common in syphilis, it occurs in 60 per cent. of the cases of disseminated sclerosis. Pupil symptoms are common in brain syphilis, likewise aphasia, alexia, and cortical epilepsy. The scanning speech affection of disseminated sclerosis should be differentiated from the dysarthria and bradyphasia of syphilis. Visual affections are common in both diseases, but complete optic atrophy and hemianopsy are not met with in disseminated sclerosis. I have, however, seen two cases of multiple syphilitic focal lesions, the result of syphilitic arteritis, in comparatively young women, in whom there was scanning speech, increased deep reflexes, spastic limbs, Babinski's sign, and nystagmus. One case in particular I have in mind. At the autopsy I found an old syphilitic arteritis with a focal sclerosis in the pons ; there was also degeneration of the ascending and descending long tracts of the cord. The patient showed no signs of syphilis on the body, but she may have had it, as she was unmarried, and yet had had a child. It is probable that such a case might have given the serum reaction, and possibly the cerebro-spinal fluid also would have yielded a positive result.

Embolic softening may occur in a subject of antecedent syphilis, the existence of valvular disease of the heart and the sudden onset of brain symptoms should serve to form a diagnosis.

Cerebral Tumours

Cases of cerebral tumour without motor or sensory troubles are not infrequently sent to asylums, and, according to my experience, they are as often as not called ‘ general paralytics ’. Examination of the fundi in most cases would have revealed optic neuritis, a condition never found in general paralysis, although it may occur in syphilitic brain disease ; but as a rule, according to my experience, syphilitic gummata and syphilitic meningitis do not produce the same degree of swelling of the disk that non-syphilitic tumours do ; very much, however, depends upon the situation and the rapidity of growth of the tumour. Large slow-growing tumours of the frontal lobe occurring in men at the prime of life and with a history of syphilis and drink may be especially difficult to differentiate from the slow demential form of general paralysis ; especially is this so when the tumour destroys the left frontal lobe and irritates the adjacent motor cortex, as it would cause epileptiform seizures and speech affections from the involvement of Broca's convolution. I have recorded a case in vol. iii, *Archives of Neurology*, of such a nature, in which the pupils were unequal, there was no optic neuritis, no vomiting, no severe headache. He was seen later by Dr. Percy Smith, who agreed with me that it was a case of general paralysis ; he was then certified and sent to the asylum. The attendants there said he was a general paralytic, but not an ordinary case. At the post-mortem examination a very large slowly-growing fibro-endothelioma was found ; the tumour was not very vascular ; it had gradually destroyed nearly the whole of the left frontal lobe, but not the ascending frontal convolution. Not infrequently the effect of treatment by mercury injection is associated with diminution of the swelling of the disks, and even when there is no history of syphilis this result would point to its being the probable cause. I recently saw a woman in one of the London County Asylums, and had her transferred to Charing Cross Hospital. Mr. Collins found five dioptres of swelling in each disk. After a course of mercurial treatment the swelling went down rapidly to two dioptres, and from being unable to read large print, she could read quite small, the headache ceased, and the vomiting no longer occurred. The cerebro-spinal fluid of this case did not give the Wassermann reaction, although it contained a considerable excess of lymphocytes; but then we know that in only about 25 per cent. of cases of syphilitic brain disease does the cerebro-spinal fluid give a positive antibody result. Lymphocytosis by itself is not sufficient evidence to prove that the disease is syphilitic, but the result of treatment combined with this makes it fairly certain that it was a syphilitic gumma that caused the symptoms in this case. When a gumma has gone on to the later stages of necrobiosis and formation of dense scar tissue, as not infrequently happens in syphilitic neoplasms of the brain, the chances of successful treatment by mercury and iodide of potassium are more improbable. If epileptiform convulsions or epilepsy have become established, it is no proof, therefore, that it is not syphilitic because the fits do not cease after administration of antisyphilitic remedies. I have seen quite a number of such cases which have been treated efficiently with antisyphilitic remedies in which the fits continued, and which at post-mortem examination still showed an old caseous focus commingled and surrounded with dense scar tissue; consequently the treatment failed to produce resolution, and the symptoms of irritation had continued. The early diagnosis of a syphilitic gumma is therefore of great importance for successful treatment. A gummatous pachymeningitis giving rise to headache and pain on pressure, but without the general signs of increased intracranial pressure—namely, optic neuritis and vomiting—may occur. I have seen such cases with localising symptoms, and one which I diagnosed during life in Hanwell Asylum was of interest, inasmuch as it failed to yield to antisyphilitic remedies, but had it been transferred to the hospital it could have been treated surgically with almost certain success (vide p. 87).

General Paralysis

It will be gathered that my object hitherto has been mainly to exclude from the diagnosis general paralysis, but in doing so I have alluded to most of the mental and bodily symptoms of this disease. Although grandiose delusions are very common in general paralysis, and occur in the majority of the cases, sometimes indeed persisting from the earliest period when the disease is diagnosed until the fatal termination, yet some cases of paralysis are associated with marked mental depression and hypochondriasis, while others are characterized simply by a progressive paretic dementia.

There are many types of general paralysis; but there are a few phenomena which are seldom or never absent: (1) progressive dementia affecting the mind in its totality usually accompanied by elation, motor activity, and grandiose delusions, sometimes by depression, motor inactivity, and hypochondriacal or persecutory delusions; (2) pupillary affection—the pupils may be unequal, they are generally irregular and react sluggishly or not at all to light, but react to accommodation; (3) progressive paresis with tremor, especially affecting the tongue and face muscles; (4) hesitant, tremulous, slurred speech with elision of syllables; (5) similar affection of the handwriting, and often, even in the early stage of the disease, the subject matter denoting dementia and delusions combined with the tremor, the slurring or repetition of letters and syllables, suffice for a diagnosis; (6) altered knee-jerks generally exaggerated, sometimes absent on one side, or on both sides without Babinski's sign or ankle clonus. When the above symptoms are present there is little difficulty in diagnosis, but in the earliest prodromal stage, sometimes termed 'the medico-legal', there may be considerable difficulty in forming an opinion, and the most experienced authorities make mistakes. The mental symptoms have already been fully described on pp. 250–76.

It is in cases of doubtful diagnosis that the pathologist can afford help by the employment of methods of examination of the blood and cerebro-spinal fluid which I have fully described in Chapter VI.

Tabo-paralysis. At least 10 per cent. of the cases of paralytic dementia commence with spinal or optic symptoms of tabes, and for many reasons adduced this is not surprising; at the same time it must be borne in mind that every case of tabes with mental symptoms is not necessarily one of tabo-paralysis. It is of very great importance to the patient and friends of the patient to be able to make a diagnosis of tabo-paralysis ; for it may be the means of guarding against medico-legal actions and other unfortunate results arising from the oncoming mental trouble, and it is of supreme importance in connexion with prognosis of life and the future treatment of the case. I will consider some of the points in connexion with the diagnosis. Tabetic patients are apt to suffer with neurasthenia and mental depression and to resort to alcohol ; moreover, to relieve the pains morphia may be administered by the doctor and the patients may acquire the morphia habit. I have seen several cases of tabes who had acquired the morphia habit admitted to the asylums suffering with hallucinations and delusions, usually of persecution ; one case of mine who had acquired the morphia habit was admitted to Hanwell Asylum ; he was diagnosed as tabo-paralysis, but his hallucinations and delusions all cleared up after a short time and he was discharged. Neurasthenic or potentially insane tabetics may take to drinking and develop acute alcoholic hallucinations, and after a variable time in the asylum, owing to the withdrawal of stimulants, may recover their mental stability. Again, a paranoiac may suffer with tabes and systematized delusions of persecution may arise in such a patient ; the pains and the visceral crises symptomatic of the tabes may become associated with systematized delusions of persecution, by individuals who turn on electricity, who thrust hot pincers into their flesh, who administer poison in their food, who twist their bowels, who withdraw their semen, who make them impotent.

Seeing that neither the Wassermann reaction of the blood and cerebro-spinal fluid, nor the lymphocyte reaction will help in such cases, for both tabes and tabo-paralysis give these reactions ; moreover, the pupil phenomena are the same in tabes and paralytic dementia, it may, therefore, be very difficult to decide whether a tabetic patient thus mentally affected is suffering from tabo-paralysis in the early stage of mental decay or not ; it matters not, for in any case such an one is a fit and proper person to be certified as of unsound mind and possibly dangerous to himself and others, and future events will clear up the diagnosis ; for not infrequently I have found tabetic patients the subject of delusions and hallucinations subsequently develop progressive paretic dementia. Apoplectiform, migrainous, or epileptiform seizures, the knee-jerk present on one side and absent on the other, point to organic cerebral disease, and in the majority of cases, especially if the patient is under 45 years of age, the case will turn out to be tabo-paralysis ; not, however, invariably, as the following case shows :—

Case 41. C. C., occupation, labourer at the Arsenal, afterwards railway signalman, was admitted to Cane Hill Asylum, aged 55, married 27 years, no children, wife had two premature births ; there was a definite history of syphilis four years before marriage at the age of 24. Four years before admission to the asylum he suffered with lightning pains and bladder troubles, and later ataxia in gait and station. He gave way to intemperance and developed delusions of persecution which caused him to be certified as insane. After admission he had several epileptiform seizures which caused a left *hemianaesthesia* and *hemianopsia* and great inco-ordination in the movements of the left hand. He had no speech affection nor tremor of lips and tongue ; there was only a very mild degree of dementia ; his knowledge of time and place were fairly good, likewise his memory for ordinary events of his past life. The autocritical faculty was preserved and he was able to describe the attacks he had had, although after the fits for a time he was somewhat dull and confused. When he awoke from sleep he said that he did not know that he had any left side of his body, nor could he feel his moustache on the left side ; he did not feel the mug between his lips properly on that side. The field of vision tested roughly showed a left hemianopsy. The patient died of broncho-pneumonia. Multiple softenings due to arterio-sclerosis of the right hemisphere were found post mortem to account for the seizures and the hemiparesis, inco-ordination, hemianaesthesia and hemianopsy of the left side (vide full description of case, *Archives of Neurology*, vol. ii, p. 172).

Neurasthenia with tabes. This combination is one, however, which is of great difficulty to diagnose, for neurasthenic symptoms may be prodromal of mental affection and tabo-paralysis ; the presence of the spinal cord lesion, and therefore parasyphilis, excludes both sero-diagnosis and lymphocyte reaction as well as the Argyll-Robertson pupils as a means of differentiation of a combination of tabes and neurasthenia from the prodromal stage of paretic dementia. The type of neurasthenia which is most difficult in tabes to differentiate from the prodromal stage of tabo-paralysis is the hypochondriacal form with syphilophobia ; as a rule, however, we can allay the fears of a neurasthenic, and he will for a time, at any rate, listen to reason ; the paralytic as a rule will not ; moreover, in the paralytic there is usually some evidence of progressive dementia, history of seizures, alteration of the moral sense, slight speech affection or some one or other of the signs and symptoms mentioned ; but cases may arise in which it is much safer to venture only upon a guarded prognosis and a probable diagnosis.

CHAPTER X

TABES

Although tabes dorsalis and general paralysis are combined in at least 10 per cent. of cases, and many authorities, Nageotte, Fournier, and Ferrier, like myself, look upon them as one disease affecting different parts of the nervous system, yet in the description of the symptomatology, the diagnosis, prognosis, and treatment, it is better to consider them separately.

Tabes Dorsalis

Synonyms. Locomotor ataxy; posterior spinal sclerosis. *Definition.* A progressive degeneration of the nervous system involving the posterior roots and their intraspinal projections within the posterior columns, causing various sensory disturbances including muscular inco-ordination and disorder of gait and station.

Historical introduction. Hippocrates and his followers spoke of *φθίσις νωτιάς* indicating a wasting disease of the spinal cord; they attributed it to the loss of sperm, the result of onanism or venereal excesses. This affection was probably a form of sexual neurasthenia. ‘That true tabes ever existed in Europe before the introduction of syphilis in the fifteenth century is more than doubtful. The retention of the name tabes dorsalis or (dorsualis) by the older German writers for the disease as we now understand it, though strictly correct according to modern pathology, tended largely to create confusion and excite prejudice against its unfortunate victims’ (Ferrier).

The history of our progressive knowledge of the symptomatology and pathology of this disease is admirably summed up by Möbius in his classical work ‘Ueber die Tabes’. In Germany and France true descriptions of the disease were almost simultaneously and certainly independently given by various observers. Formerly all possible forms of paraplegia and paraparesis were included under 'Tabes dorsalis' until Ollivier, 1824, Hutin, 1827, and Horn, 1827, led the way to a recognition of this disease as a distinct clinical entity. To Cruveilhier (1835–42) belongs the merit of having described, in his studies upon paraplegia, the case of a woman, aged 52, with anaesthesia of the legs, with stumbling gait, painless fracture of bones, &c.; at the post-mortem examination a yellowish-grey degeneration of the spinal cord was found, which involved the whole of the posterior columns in the lower part, but only the median portion in the cervical region. The important point is that Cruveilhier connected the sensory disturbances observed during life, with this degeneration of the posterior columns. Sir William Gowers gives to Todd the credit of the 'discovery' of this disease. Certainly Todd, 1847, drew a clear distinction between paralysis and inco-ordination and was the first to connect inco-ordination with disease of the posterior columns of the spinal cord, yet I entirely agree with Möbius and Ferrier in assigning the first place to Romberg (1840–57); for there is no doubt that he first gave a systematic account of the etiology, symptomatology, diagnosis, prognosis, and treatment of tabes. 'In his *Lehrbuch der Nervenkrankheiten* he describes the characteristic gait, the pathognomonic symptom now called by his name, the increase of the ataxic disorders on shutting the eyes, the shooting pains, anaesthesia and paraesthesia, the bladder troubles, the affections of vision, and the striking myosis and fixity of the pupils. He mentions the relative infrequency of tabes in women, and as to prognosis he utters the gloomy verdict: to none affected by this malady is there any hope of recovery; 'über alle ist der Stab gebrochen' (Ferrier).

He noted the atrophy of the spinal cord, especially of the lower part of the lumbar enlargement, he also observed the atrophy of the cauda equina and, what is of still greater interest, he observed that the posterior roots are sometimes alone affected; at other times along with the posterior columns, while the anterior roots appear normal. 'Romberg, however, did not clearly differentiate the basis of ataxy from that of muscular paresis or paralysis, and he describes as equally belonging to tabes leathery induration of the white substance, and, more frequently, softening of the grey matter.'

Duchenne, 1858, by his masterly clinical genius clearly differentiated the affection from muscular paralysis or paresis occurring in the various forms of so-called general spinal paralysis and unclassified forms of chronic myelitis, naming it after the most striking symptom 'ataxie locomotrice progressive'. Trousseau in his brilliant lectures spread abroad the knowledge of the affection which Duchenne had vivified in his published researches on 'ataxie locomotrice', calling it Duchenne's disease, thereby doing scant justice to previous observers.

Russell Reynolds (1855) and Gull (1858) supported Todd in his views. As to priority, it may be said that the knowledge of tabes grew independently in all three countries, and from the year 1860 onwards tabes or locomotor ataxy was everywhere a recognized disease in medicine. Still every year since has brought forth fresh observations showing the protean nature of this disease, and although in many books it is still called by the name given it by Duchenne, nevertheless 'locomotor ataxy', although it expresses a very characteristic feature of the disease has this objection: it is a symptom which does not occur in the first stage (preataxic) of the disease; indeed a long period of time may elapse before ataxy comes on, and sometimes the patient, after suffering a great number of years from the disease, may die from some intercurrent complication having never been ataxic. Hughlings Jackson, in 1881, when discussing the eye symptoms in locomotor ataxy stated: 'There are many cases of locomotor ataxy without ataxy; for these cases "locomotor ataxy" is strictly a misnomer; tabes dorsalis is better, since it covers cases with and without abnormal gait.'

It is impossible even to enumerate the history of all the important additions which have been made to our knowledge of this disease, but there still remain some few which require mention.

Of especial importance were the discoveries of the reflex pupil rigidity by Argyll-Robertson (1869), and the absence of the knee-jerk by Westphal in 1875. Gastric crises had been described by Delamare in 1866, but it was Charcot (1868) who gave a masterly description of them as well as of the arthropathies; this was later extended to spontaneous fractures (1873) and the tabetic foot (1883). Duplay and Morat pointed out the perforating ulcer in 1873. As the clinical knowledge of the condition has extended so also has the macroscopic and microscopic anatomy. The minute anatomy of the morbid changes in tabes may be said to have been commenced by Virchow 1855 and Rokitansky 1857. The latter described it as 'a proliferation of the structureless ependyma-like connective tissue and stroma of the nerve-centres which caused destruction of the nerve elements proper and resulted in induration or sclerosis of the affected parts'. But Bourdon and Luys were the first to make important microscopical investigations in reference to the well-defined group of symptoms in tabes. They described the condition as sclerosis of the posterior roots the final result of a chronic inflammatory process. Charcot, Vulpian, Gull, and others held similar views as to the inflammatory origin of the degeneration. Von Leyden (1863), however, maintained that it had more the characters of a simple atrophy, and the inflammatory changes which might be seen in the membranes and around the vessels were either secondary or accidental. Von Leyden did not, however, at that time, as he has in later times, causally connect the posterior column atrophy with the atrophy of the posterior roots or sensory nerves.

Pierret, 1871, observed that the primary lesion of tabes did not consist in a degeneration of the posterior columns as a whole, but in two symmetrical islets of small extent situated in a special region of the posterior column, 'les bandelettes externes' of the columns of Burdach; thus tabes came for a time to be considered as a system disease or sclerosis of the postero-external columns. Vulpian, 1879, however, maintained that a primary degeneration of the posterior columns could not lead to atrophy of the posterior roots, seeing that their trophic centre was in the posterior spinal ganglia, and he therefore regarded the atrophy of the roots as of primary origin; the *bandelettes externes* might be also, but only in so far as they consisted of fibres endogenous in origin; it would otherwise be contrary to the Wallerian law of degeneration. 'He proposed to substitute for the formula "sclerosis of the posterior columns", "sclerosis of the posterior roots" as the primary basis of tabes. He thus inaugurated the radicular or root theory of tabes which is now entertained in one form or another by the majority of neuropathologists' (Ferrier).

Symptomatology. The signs and symptoms of tabes are manifold, but the fundamental ones which are seldom absent are: (1) reflex pupil rigidity, (2) lightning pains, (3) absence of deep reflexes, (4) some visceral disturbance especially bladder troubles, (5) disturbances of sensibility, (6) lymphocytosis of the cerebro-spinal fluid.

All these symptoms may be present as well as many others in the early stages of the disease, and there may be no ataxy; in such cases the disease is said to be in the preataxic stage.

Eye symptoms. Pupil changes are met with in the great majority of cases of tabes and tabo-paralysis. Before the discovery of the Argyll-Robertson phenomenon, inequality of the pupils afforded a valuable sign of the disease; likewise very small pupils; and even now the knowledge of the frequency of such alteration, by attracting the physician's attention, may lead to his making a more careful examination of a case which presents urgent symptoms pointing to organic disease of internal organs; e. g. a case (which was transferred to my care) was admitted for acute intestinal obstruction; the surgeon who was called in to operate had his attention attracted to the very small pupils, while the man (who it was ascertained had had no opium) was suffering extreme agony; this led to the discovery that the man had a distended bladder and was suffering from a very severe gastric crisis. The loss of the reflex contraction of the pupils to light, while it remains upon convergence and accommodation, is the most valuable sign of tabes and tabo-paralysis and general paralysis; this is known as the Argyll-Robertson pupil, the frequency of which was first noted by Erb, as well as the usually associated loss of the reflex dilatation to sensory or psycho-sensory stimulation. This pupil sign is not always present, as the subjoined statistics which I obtained from 150 hospital and asylum cases show.

Tabes. Hospital cases.	*Tabes or tabo-paralysis. Asylum cases.*
73·5 per cent. Argyll-Robertson phenomenon on both sides	70 per cent.
3 per cent. Argyll-Robertson phenomenon on one side	7 per cent.
3·7 per cent. sluggish to light	4 per cent.
15 per cent. inactive to light and accommodation .	20 per cent.

But it is so frequent, being found generally in about three-quarters of the cases, and so characteristic, that in its absence, unless the other symptoms of tabes are very well marked, it would be unsafe to make a diagnosis of tabes. Occasionally in tabes and more often in tabo-paralysis and general paralysis, paradoxical reaction to light occurs ; viz. on removal of the shading hand no reaction takes place for a second or two, then the pupils dilate slightly. Möbius thus explains the phenomenon: probably during the process of covering the eyes the patient is accommodating, and when the shading hand is removed accommodation is relaxed, the process of accommodation being a slower process than the light reflex.

A sluggish reaction to light is not necessarily pathological, and unless there is a difference between it and accommodation it may be of no import. As shown in the above statistics, it is occasionally unilateral, or it may be more marked on one side than the other. In a large proportion of cases the pupils are unequal, in a very considerable proportion they are smaller than normal ; they may be of medium size or even larger than normal on one or both sides. The essential and characteristic feature is reflex iridoplegia, and this when once complete is incurable ; but occasionally when incomplete the reaction may return. The outline of the pupils also generally undergoes changes, and irregular pupils not infrequently precede the loss of the light reflex. The tabetic pupils are rarely quite circular and often they are one or both eccentric in position. The Argyll-Robertson pupil may exist for years without any other obvious sign of tabes or general paralysis. It is usually associated with lymphocytosis of the cerebro-spinal fluid, but this is not invariable. So rarely does it occur in any other disease than tabes and general paralysis and as a consequence of congenital or acquired syphilis, that a person having this sign and presenting no other symptoms may, as Babinski has said, be regarded as a candidate for one of these two parasyphilitic affections. 'The general result, therefore, if we consider the syphilitic origin as proven, is that reflex iridoplegia is always a result of syphilis.'

Paralysis of the external muscles is also common in tabes, and one of the first symptoms which brings a tabetic patient under medical examination may be a squint and double vision; thus not an inconsiderable proportion of cases are seen first by the oculist (vide Figs. 29 A and B). The paralysis may be transient, lasting a few days or a few weeks and then disappearing. There may be permanent paralysis, complete or incomplete, of a single nerve. Any muscle may be affected, but the external rectus is the muscle most often affected. A transient ptosis may precede an almost complete ophthalmoplegia, or there may be a persistent paralysis of the levator palpebrae. Sometimes the whole third nerve is involved. In 22 of my hospital cases there was double vision of a transitory nature; it was a very early symptom in nearly all the cases. There were 9 cases of ptosis (in 4 associated with strabismus) and 4 of nystagmus. In 11 cases there was permanent ocular paralysis, 4 partial of the third, 1 of the fourth, and 5 of the sixth. In 1 case there was bilateral internal and external ophthalmoplegia. These cases with ocular symptoms were unusually numerous owing to the fact that many were sent to me from the Westminster Ophthalmic Hospital or the Eye

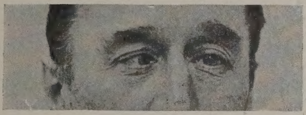

FIG. 29 A. Tabo-paralysis. Paralysis of the right external rectus.

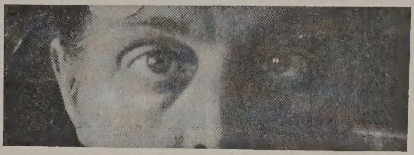

FIG. 29 B. Photograph of a female patient suffering with early tabes. Paralysis of the right internal rectus, with inability of convergence of the right eye. Double vision.

Department of Charing Cross Hospital. Among the asylum cases of tabo-paralysis, paralysis of the ocular muscles was much less frequently met with. In only 8 was double vision described as an early symptom—13·3 per cent. Permanent ocular paralysis occurred in 4 cases, 2 of unilateral ptosis, and 2 of unilateral sixth nerve paralysis.

Optic tabes. Atrophy of the optic nerve is one of the most serious symptoms that can arise in tabes ; it is an early, indeed a very early symptom, and the defect of vision or blindness may be the first cause of the patient seeking advice ; its frequency is difficult to ascertain. Sir William Gowers states that optic atrophy occurred in 26 of 400 cases he had seen, that is, 6·5 per cent. ; according to Voigt, 1 in 14 suffer from optic atrophy ; according to Leimbach, it may be the first symptom in 1·5 per cent. Among my 65 hospital and infirmary cases, there were 20 with optic atrophy and 10 of them were completely blind. A great many of them remained in the preataxic stage many years ; others became general paralytics and died. The large number of these cases was due to the fact that a considerable number were sent to me from Ophthalmic Hospitals. Again, if we took infirmary cases it would hardly be fair, because blindness leads to incapacity to earn a livelihood. When, however, we come to consider asylum cases we find that it is extremely common in tabo-paralysis ; owing, however, to the difficulty in examining these patients ophthalmoscopically a few cases may be overlooked, but 35 per cent. of the 60 tabo-paralytic cases were found to have well-marked optic atrophy, and 50 per cent. would probably be nearer the mark, for I have found often, post mortem, optic atrophy which was not noted during life. In 150 consecutive cases of general paralysis (including the tabetic form) found on the post-mortem table at Claybury, the optic nerves were carefully examined, and naked-eye atrophy was found in only 7 per cent. ; several of these belonged to the juvenile form of general paralysis (in which it may occur independently of any degeneration in the posterior columns of the spinal cord) ; the remainder belonged to the tabetic form of the disease in adults, as ascertained by microscopic examination of the spinal cord. Optic atrophy, then, occurring in tabes is to my mind, apart from the blindness, a serious indication of the possibility of the degenerative process attacking the brain. My experience would lead me to believe that the mental worry occasioned by the blindness in a few instances tended to bring this about. The failure of vision usually commences with limitation of the peripheral field of vision in one eye and loss of colour vision; then the other is affected, or both may be affected simultaneously. The patients tell you frequently that they can see, but it is 'like looking through smoked glass'. The onset and the course may be slowly progressive. According to Dejerine the progress of the tabetic atrophy is rapid; after from 6 to 18 months the blindness is usually complete. The Argyll-Robertson pupil sign is generally present, and the dilatation of the pupil to pain is absent or diminished. As blindness becomes more complete the lightning pains are less severe. Sometimes the sight is lost, apparently in a few days, or almost suddenly. Doubtless in some of these cases there has been loss of the peripheral field of vision with the retention of central acuity, and it is the comparatively sudden destruction of the remaining fibres to the macula which leads the patient to believe he has suddenly lost his sight. It may, however, be (as Gowers suggests) due in such cases to an interstitial inflammatory process, but ophthalmoscopic examination shows no change to account for it.

Dr. Wiglesworth was one of the first in this country to call attention to optic nerve atrophy *preceding* the mental symptoms of general paralysis of the insane. In conjunction with Mr. Bickerton, he described the optic nerve changes met with in a series of 66 cases of general paralysis. They showed that while in the majority of cases of this disease the fundus oculi presented a normal appearance; in a considerable minority changes in the direction of neuritis or atrophy were found.

The credit of first describing the form of tabes known as optic tabes is usually given to Benedikt, who stated in 1881 that the abortive cases of tabes (*formes frustes*) are the ones in which optic atrophy is a prodromal symptom. Sir William Gowers in 1879, however, pointed to the frequency with which ataxy does not come on when optic nerve atrophy develops, and he remarks in the fourth edition of his *Manual and Atlas of Medical Ophthalmoscopy*, 'This fact was emphasized a few years later by Benedikt, who disregarded the great frequency of early stationary tabes and enunciated a law that the development of optic atrophy tends to prevent the occurrence of ataxy. Any so-called " law " easily obtains recognition, however doubtful are the facts on which it rests. Those which seem to support attract much more notice than those which do not.'

In 1887 Benedikt stated the law, to which he knew no exception, that tabetic motor symptoms, no matter what development they may have reached, vanish as soon as optic atrophy appears. Dejerine points out that this latter statement is not true, and I certainly agree with him. I would go further and say that it has no influence upon the ataxy, when it arises in a patient already in the second stage of ataxy ; in this respect it agrees with the fact that cortical degeneration occurring in an advanced case of tabes with *well-marked* ataxy does not cause the disappearance of the ataxy, although the advent of dementia and other signs of cortical degeneration like optic tabes certainly arrests the spinal degenerative process and modifies ataxy of the first degree. Dejerine states that the number of cases of tabes with blindness in which the disease does not progress beyond the preataxic stage is considerable. He and Martin studied 100 tabetic cases at Bicêtre, 18 of whom were completely blind, and none of these presented motor disturbance. According to my experience lightning pains usually precede optic atrophy, but not invariably. Usually when the optic atrophy occurs early, the lightning pains diminish in intensity, and even at times disappear.

An important point to remember is the frequency with which optic atrophy is followed by tabo-paralysis ; in quite 50 per cent. of the cases of this form of the disease met with in asylums (and they are fairly numerous), cerebral symptoms followed optic atrophy and blindness. In many instances the mental trouble occasioned by the blindness and loss of livelihood undoubtedly acted as the exciting cause of the brain degeneration.

I have had cases sent to me from the Eye Hospitals when I was seeing outpatients at Charing Cross Hospital and many years later found them in one of the London County Asylums suffering with paralytic dementia from which they have died.

Patients with paralytic dementia on the one hand, do not as a rule suffer with visual hallucinations, except in the acute maniacal condition, especially that accompanied by alcoholism. Cases of tabo-paralysis, on the other hand, with optic atrophy frequently have visual hallucinations.

Sir William Gowers states that Charcot believed that nearly all cases of so-called simple primary optic atrophy *develop finally* spinal symptoms, and he reports a case in which amaurosis lasted twenty years before any other symptom of tabes was noted; in another case sixteen years passed before distinct signs of tabes occurred. Every one of the numerous cases of optic tabo-paralysis that I have examined post mortem, although many of them showed no ataxy during life, yet presented upon microscopic examination well-marked degeneration of the posterior columns due to degeneration of the exogenous system of fibres and corresponding atrophy of the posterior roots.

Sensory Disturbances

Sensory disturbances are either subjective or objective, and these again are of two types: (1) destructive, causing loss of function; (2) irritative, causing abnormal or perverted function. The sensory disturbances relate to (1) common sensibility of the skin, viz. thermal pain and tactile, or (2) deep sensibility due to pressure, the complex group of sensations from tendons, joints, and muscles, termed 'kinaesthesis' or the sense of movement, (3) the nerves of special sense, (4) the visceral sensory nerves. The clinical phenomena of tabes, and, in a measure, of tabo-paralysis, are due to disturbances of these various systems of afferent sensory neurones. Although there is a symptomatic similarity among all the cases by the more or less constant presence in some stage of the disease of certain sensory disturbances, e. g. lightning pains, anaesthesia, or analgesia, which are the best examples of the two types, there is hardly ever identity of symptoms, and no two cases are exactly alike. The complexity of the symptomatology agrees with the polymorphic character of the lesions. A study of the microscopic changes in the peripheral and central nervous systems in a large number of these cases explains this general uniformity and special diversity of the symptoms. The fact that changes always occur in the posterior spinal roots and their projections in the cord explains the general uniformity in the objective and subjective sensory disturbances of the skin, muscles, and joint structures, whilst the variability of distribution and extent of the morbid process in thirty-two posterior roots, and their projections in the cord, as well as the variable degree of complication by lesions of the peripheral afferent nerves, explains the frequent diversity of precise distribution of the anaesthesia, analgesia, hyperaesthesia, and hyperalgesia met with. The sensory dissociation shows that certain fibres subserving special functions are particularly affected, e. g. the muscular sense-fibres of the lower limbs, and the nerve-fibres innervating joint structures; again the light tactile anaesthesia of the mid-thoracic region, without analgesia, shows that the disease process is selective, and is related to the intraspinal terminations of the roots and not the peripheral nerves. For, in a neuritis, the sensory symptoms have not this dissociation, nor this distribution. The existence of these sensory disturbances in the insane tabetic helps to explain many of their delusions and illusions, e. g. the idea that enemies are torturing them with electricity (it was hot irons and pincers before electricity was in general use).

The subjective disturbances of the nerves of special sense and of the viscera are still more liable to receive an insane interpretation, and give rise to delusions and illusions. There is a definite relationship between the degree of ataxy and the reflex spinal tonus, which is due to partial or complete abolition of the intraspinal paths conducting afferent impressions from the muscles, tendons, and structures around and within the joints, and this is due not only to the withdrawal of the guiding sensations, but also to muscular hypotonus.

I tested the skin sensibility in 48 successive cases of tabes and a number of cases of tabo-paralysis, and mapped out on charts the areas affected; the distribution was subsequently, when the series was completed, compared with the root distribution given by Seiffer, which is based upon an analysis of the researches of Head, Thorburn, Kocher, Starr, and Wichmann. From 32 cases where root distribution was sufficiently definitely determined, as regards tactile anaesthesia, a composite chart was made.

Method of examination. The eyes of the patient being covered the determination of anaesthesia to light tactile sensations was made by touching the patient very lightly with the tip of the finger, analgesia by pricking with a needle, and heat or cold by a test tube filled with hot water or ice. The results obtained agree in the main with those by Lähr, also Förster and Fränckel.

SUBJECTIVE SENSORY PHENOMENA OF TABES AND TABO-PARALYSIS

Lancinating pains. The pains of tabes are variable in intensity, situation, and duration. They are the earliest and most common subjective symptom and may indeed be the only one in slight and stationary cases. The patient has often suffered years before their true nature is discovered. They may be slight or severe, generally occurring in paroxysms, and are likened to stabbing, shooting, boring, or lightning, or to hot wires thrust into the flesh. A patient may be free from pains for hours, days, weeks, or even longer; they may last a few minutes and then cease, to recur again in the same situation or in another. The attacks of pain may last a day, a day and night, or several days, causing the patient the greatest suffering and agony, relief being obtained only by morphia. Rarely does the pain correspond with the distribution of the nerve, although a patient may come to the physician thinking he is suffering with sciatica. ‘ They bear no proportion to the other symptoms and are sometimes slight or altogether absent. The superficial pains seem to be on the surface or just beneath the surface. They are usually felt at one spot often only a few inches in extent, sometimes longer, extending down part of a limb, on the ears, on the face, and especially about the mouth. The pain is usually extremely brief, a stab, or flash of pain, gone as soon as felt, but recurring. These superficial pains have one remarkable effect ; they make the skin tender.' (Gowers). The seat of the pain is most varied. It may start in the great toe, and the patient thinks he has gout ; it may start in joints and be attributed to rheumatism ; or it may be felt in the skin or muscles. The skin is usually hyperaesthetic over the seat of the pain, whether it be superficial or deep, and this hyperaesthesia may last after the pains have ceased. Herpetic eruptions follow in very rare instances, for I have only met with 1 case in 60, and that subsequently turned out to be a tabo-paralytic. In one case of tabo-paralysis symmetrical bullae occurred in the limbs and trunk. Examination of the peripheral nerves showed acute degeneration of the fibres, proceeding to the skin area of the bullae ; also acute degenerative changes in the cells of the corresponding spinal ganglia. In another patient erythematous patches occurred after an attack of pain in the arms. Some patients complain of pain running in the long axis of the limbs, which they mistake for sciatica. When pain occurs in the trunk it is frequently unilateral, and not uncommonly accompanied by gastric crises. The girdle pain is frequently experienced, and a tightness compared to an iron jacket or the constriction of a tight belt is a not infrequent symptom. The pain running down the inner side of the left arm might be mistaken for angina. Very often the pains radiate all over the body, and quite a number of patients who suffer with gastric crises say that with the attacks of vomiting, pains start from the mid-thoracic region and radiate all over the body with the exception of the face. One man pointed out to me that the face was unaffected, except in an area which corresponded to the distribution of the second cervical root ; another, a woman, suffered so severely that she could hardly bear the touch of the bed-clothes, and even the light of the windows was so painful she would bury her face in the pillow ; the only part of the body where she did not suffer the severe pains during these crises was the left leg below the knee. The right leg had been amputated above the knee for Charcot's joint. The left leg, in which the pains did not radiate, was absolutely analgesic and anaesthetic below the knee. This would rather indicate that the sentient grey matter subserving painful sensation for this leg or the intraspinal terminals of the posterior spinal neurones had been completely destroyed, therefore painful sensation could not be projected outwards into the limb. That this is a more likely explanation than destruction of the peripheral nerves, is shown by the fact that pain of central origin may be referred to a limb which has been amputated.

Another of my cases was interesting as showing that a toxic condition of the blood may set up crises and attacks. This patient had a discharging sinus from a suppurating Charcot's joint ; she volunteered the statement that when pus accumulated owing to the sinus getting blocked, she was pretty sure to have an attack of vomiting associated with severe pain. When the pain is in the face it may closely simulate trigeminal neuralgia, only it is usually bilateral.

In the tabo-paralytics or tabetics with mental symptoms these attacks of pain may be insanely interpreted ; they are therefore, rather illusions than delusions. These patients often believe they are being tortured by unseen agencies, that electricity has been turned on by their enemies ; they have been given poison which has gone into their legs and feet. They may associate the pains experienced with dreams or visual hallucinations ; and they may tell you (as in two cases which came under my notice) that lions and wolves came and gnawed their limbs by night, and will beg you not to let them be tortured again. The pains may last during the whole course of the disease, but frequently in the third stage of the disease, when the roots which are undergoing degeneration have become completely destroyed, the pains abate or cease ; that is if the disease does not steadily spread up to affect the arms. When marked dementia supervenes in spinal tabes it is usually associated with abolition of the painful sensations caused by pricking, and the patient as a rule does not complain of attacks of pain or torture ; in this respect markedly differing from the tabetic with delusional insanity, who probably suffers more than the sane tabetic, as he is not only tortured with physical pain, but also with delusions of persecution by unseen agencies—the true pains forming a realistic basis to the delusions around which the whole psychical existence may centre. Nearly all cases of tabes with mental symptoms (twelve in number) which came under my observation were the subjects of insane inheritance, and we may consider these cases as tabes occurring in persons potentially insane—the organic disease being sufficient to act as a determining factor of insanity.

Paraesthesia. Subjective sensations of various kinds, as numbness, pins and needles, formication, a cold trickling feeling in the skin, a feeling in the soles of the feet of walking on putty, wool, or velvet may be complained of. In rare cases Hutchinson's mask, due to affection of the fifth, occurs. The patient says his face feels stiff, and he feels as if it were covered with a cobweb. Paraesthesia of the arms, like the pains, affects the post-axial border of the limb, the distribution of the (eighth) cervical and first and second dorsal roots. Consequently patients often complain of numbness and tingling in the ring or little fingers. The insane tabetic may put a false interpretation upon these abnormal subjective sensations, e. g. one patient said mice were running over her in bed at night, and she saw them on the pillow. Another used to get up at night and brush the flies out of his bed. Another had a feeling of cold water running up his back and over his head as far as the forehead, but not on to his face. The subjective sensation he insanely associated with the medicine he had had given to him at the London Hospital, which he asserted took the course in his system of this subjective sensation. It was of interest to learn from this patient that he had been warned by another patient that if he repeated this statement before the magistrate he would be sent away to the asylum. 'But he had to speak the truth'—so convinced was he that the medicine was the cause of his trouble.

Objective Sensory Disturbance

I carefully examined 48 successive cases of tabes for cutaneous sensory disturbances. In 42 of these objective cutaneous sensory disturbances were found; the 6 cases in which no cutaneous disturbances were found were all in the preataxic stage. Several of these preataxic patients had had, however, subjective sensory disturbances. There were two other cases in the preataxic stage in which gastric crises were associated with light tactile sensory disturbances of the mid-thoracic region and no sensory disturbance elsewhere. Trunk anaesthesia to light tactile impressions is the earliest and most constant objective sensory disturbance. In 36 cases there was anaesthesia of the trunk to light tactile sensation, and of these 36, 12 suffered with gastric crises. No patient suffered with gastric crises that did not develop sensory

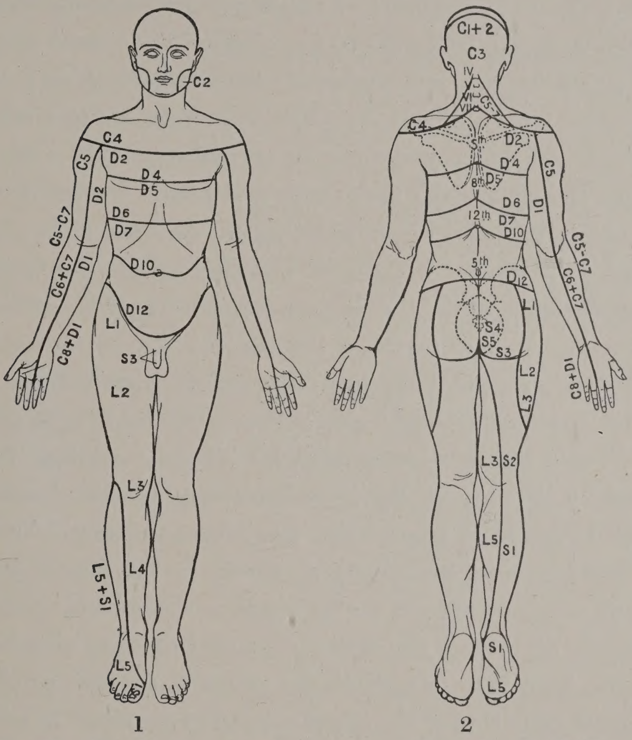
C2
C4
C5
D2
D4
D5
D2
D6
D7
C5-C7
D10
C6+C7
D1
D12
L1
C8+D1
S3
L2
L3
L4
L5+S1
L5
1
C1+2
C3
IV
V
VI
VII
C3
C4
5th
D2
D4
C5
8th
D5
D6
D1
12th
D7
D10
C5-C7
5th
D12
C6+C7
L1
S4
S5
S3
L2
C8+D1
L3
L3
S2
L5
S1
S1
L5
2

Fig. 30. Distribution of posterior roots to the skin, after Seiffer. (1) Ventral surface. (2) Dorsal surface.

trunk anaesthesia. In most cases the affection was bilateral and symmetrical or nearly symmetrical, both upper and lower borders forming a sharp horizontal line which corresponded to the zones of distribution of the roots shown in the accompanying diagrams, Fig. 30. In this zone of anaesthesia to light tactile impressions, there may be a zone of analgesia or hypalgesia, or scattered points of blunted painful sensation. The area of anaesthesia or hypaesthesia of the trunk was usually more considerable than the analgesia or hypalgesia. The zone of hypaesthesia or anaesthesia is occasionally only unilateral, or it may be asymmetrical extending over more segments on one side than the other. There may be one or several segments anaesthetic, the most frequent being the fourth and fifth. Sometimes a segment above or below is hypaesthetic. In two cases the area supplied by a dorsal branch or branches of the posterior root was unaffected, while the area supplied by the anterior was anaesthetic. In one instance the patient was anaesthetic only over an area supplied by the posterior divisions of the fourth and fifth roots of the right side; then after an attack of severe pains in this region accompanied by bilious vomiting, the area supplied by the anterior divisions became affected and eventually a complete girdle of anaesthesia was found to exist. The trunk anaesthesia is most frequently met with in the fourth and fifth segments; it may extend up the chest to the third or the second interspace, and then the inner side of the arm also becomes affected. This may extend to the whole inner side of the arm, or only the inner side of the upper arm and forearm. In advanced cases, or cases commencing in the arms, there may be light tactile anaesthesia continuous with the thoracic anaesthesia affecting the whole inner half of the arm, and corresponding to the distribution of the second dorsal, first dorsal, eighth cervical and seventh cervical—that is, the whole post-axial border of the limb. It does not extend beyond the second intercostal space on the trunk, because it is very seldom that the upper cervical roots which enter into the formation of the cervical plexus are affected. In one very advanced case of tabes the whole of the skin distribution of the brachial plexus was anaesthetic. In this case there was continuous anaesthesia from the fifth cervical to the fifth sacral, inclusive. In four cases the cutaneous anaesthesia of arms, trunk and legs was continuous. In twelve cases the arms were affected, but only three times did the anaesthesia extend to the radial side of the median line.

Whilst a considerable number of the tabo-paralytics show subjective sensory phenomena at some period of the disease, in only some cases can objective phenomena be demonstrated; indeed the appearance of the mental symptoms apparently not only diminishes the ataxy, but the anaesthesia and analgesia as well. One reason why more ataxy and more marked objective sensory disturbances are not met with in tabo-paralytic cases may be that a great many of them are in the preataxic stage, and, owing to the progressive brain affection, they become so demented that they cannot be satisfactorily tested, or they die before a sufficient number of root-fibres are destroyed to produce such objective phenomena.

In 33 cases of tabes which I examined the legs were analgesic or hypalgesic. There was usually complete insensibility to the prick of a needle, or the feeling only of something touching below the knee in all cases of tabes of the third stage, and often also in the later portions of the second stage. In a great many instances this analgesia was accompanied by light tactile anaesthesia. This anaesthesia was often associated with genital, perineal, and anal anaesthesia indicating involvement of the lower four sacral roots, whereas the parts below the knee indicate fourth and fifth lumbar and first sacral. Analgesia or hypalgesia of the lower extremities is sometimes limited to the sole of the foot or the peroneal surface of the lower part of the leg; it may exist independently of trunk anaesthesia and be the sole objective evidence of sensory disturbance. A patient may previously show no cutaneous disturbance and then anaesthesia or analgesia develops after several attacks of pain.

Hyperaesthesia and hyperalgesia. An area in which pains have been experienced, whether in the trunk or limbs, may be hyperaesthetic and precede anaesthesia or analgesia; it indicates the irritation prior to destruction of the root-fibres or their intraspinal projections. Very frequently an area may be hyperaesthetic above or below a complete anaesthetic or analgesic area. A zone of hyperaesthesia is therefore frequently met with above the third or fourth thoracic interspace, or below the seventh or eighth. Again, there may be a patch of hyperaesthesia situated within an anaesthetic area; or on one side of the trunk, or in one limb, there may be hyperaesthesia or hyperalgesia, while corresponding parts, or nearly corresponding parts, of skin on the other side may be anaesthetic. Systematic microscopic examination of the spinal cords and their roots serves to explain these facts. Thus I found in pretty advanced cases of tabes a more complete degenerative fibre-atrophy in the lumbo-sacral and mid-dorsal regions than in the remaining segments of the cord. Except in arm tabes, the degeneration of the roots ceased about the eighth or seventh cervical segments. This explains also the fact of the distribution of the anaesthesia

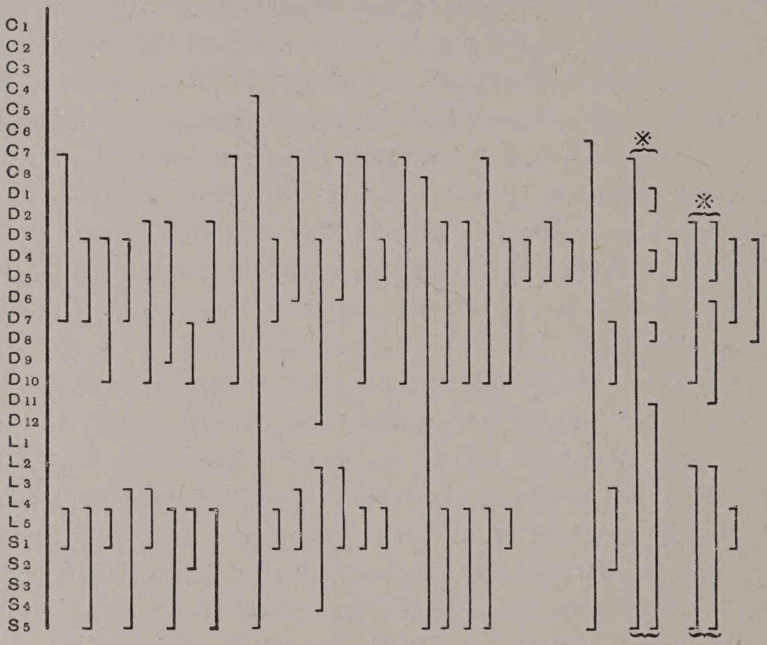

FIG. 31. Diagram illustrating, approximately, the distribution of cutaneous anaesthesia in the posterior root areas of thirty cases of tabes and tabo-paralysis. Two cases showed unequal affection of the two sides. This diagram shows the regions least affected are the upper cervical, lower dorsal, and upper lumbar.

shown in the diagram (Figs. 31 and 32). Again, on one side we may have roots completely destroyed, while corresponding roots on the other side are only partially destroyed or little affected. The unequal affection of roots will not only account for cases where there is asymmetrical distribution of anaesthesia and analgesia, but also for hyperaesthetic zones on one side, with anaesthetic on the other; likewise, a widespread distribution of anaesthesia and analgesia, in the midst of which are islands of varying size which are still sensitive to light, tactile sensation, or pricking of a pin, may be accounted for by the fact that some of the posterior spinal neurones, with their spinal projections and intraspinal terminals, are still intact. As the diagram shows, and as the charts in fairly advanced cases (pp. 341–9) of tabes show, there is usually a gap in the regional distribution of anaesthesia over the abdomen and thighs; these skin areas are supplied by the lower dorsal and upper one or two lumbar roots, and it is

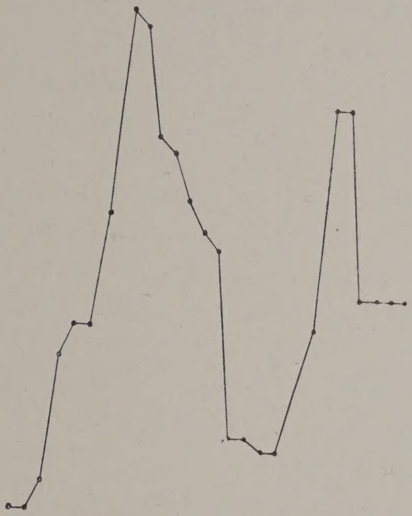

FIG. 32. This curve is constructed from the previous diagram. The summit of the first elevation corresponds with the fourth dorsal, the summit of the second elevation with the fifth lumbar and first sacral. It is possible that each of these elevations denoting tendency to degeneration of intra-medullary portions of posterior roots may be dependent upon some morphological condition, the most likely being a precarious vascular supply; indeed, this is not improbable, for these regions of the cord depend more upon small and variant arteries for their blood-supply than the cervical, lower dorsal, and upper lumbar regions.

these roots which microscopic examination shows to be less affected. Now this region is usually sensitive to pain and touch, and, indeed, may be hypersensitive. In one case where the skin was hypersensitive on the right side, deep inspiration and even movement caused severe pain, and the patient was thought to have pleurisy. The epigastric reflex was brisk on that side, whereas on the left side, where the skin of the abdomen was analgesic and anaesthetic, the epigastric reflex was absent ; the cross reflex was, however, obtained.

Superficial reflexes. The superficial reflexes, as the previous statement indicates, are directly correlated with the skin sensibility, consequently the epigastric reflexes (excepting in very advanced cases) are generally obtained. The plantar reflexes are generally diminished or abolished ; the cremasteric and gluteal reflexes are more often present than the plantar, because, as we have seen, the plantar surface next to the mid-thoracic region is the most likely to have sensibility defective or abolished. When there is no impairment of sensation, it is uncertain whether the superficial reflexes are impaired or abolished ; indeed in the early stages of the disease there may be a considerable exaggeration of all the cutaneous reflexes.

Summaries of a few interesting tabic cases with charts, showing the areas of distribution of cutaneous anaesthesia and analgesia from cases, the full reports of which are given in 'Tabes in Asylum and Hospital Practice', vol. ii, *Archives of Neurology*, F. W. Mott.

Case 42. Female, aged 53. No history of syphilis, but miscarriages and still-born children, no living children, pigmented scar on buttock. The husband died five years after marriage in an asylum of *general paralysis*. She remained a widow, and four years later married again, no children by second husband. She had a Charcot knee-joint for which the right leg was amputated. There were no signs of ataxy then ; the joint affection came on in the leg with which she worked the treadle of a sewing-machine. Not long after this, she developed gastric crises which were very severe and she was obliged to go into Lewisham Infirmary. At the time she had her leg off she had Argyll-Robertson pupils, but no affection of the bladder and bowels. There were many other points of unusual interest in her case that are worth recording, and which may be correlated with the accompanying chart, indicating a progressive degeneration of posterior roots, viz.—Feeling of wool on the sole of the foot. Pins and needles of left hand. Marked loss of sense of position in joints of lower limb; not marked in hands. No great amount of muscular wasting, but *marked* hypotonus of left leg. Knee-jerks absent. For sensory disturbances of skin, vide charts. *Visceral symptoms*

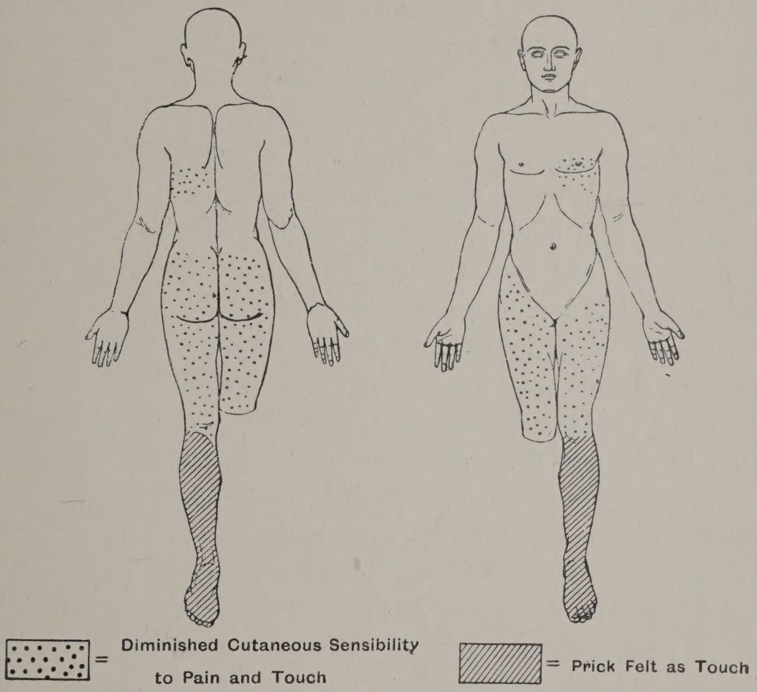

FIG. 33. Charts from Case 42.

—She is subject to very severe gastric crises, which are preceded by intense occipital headache, and a feeling of distension of the stomach, and this is followed by attacks of lightning pain through the whole body; *this pain does not, however, extend beyond the left knee,* but into the stump of the right knee. It affects the left arm and fingers more than the right. The pain lasts from one to three days, and she is in the greatest agony. She gets no relief until she has taken a large dose or two of trional. She cannot bear the light to the eyes, and has to lie on her face during the attack. She obtains no relief from hot bottles or fomentations. Swallowing ice gives some relief. She has on occasions vomited coffee-ground matter, but never bright blood, and she has experienced relief afterwards. This was her own voluntary statement without the need of any questions being put. She has only one tooth in the upper jaw, and two in the lower. She tells me that they have all dropped out. Two years ago five dropped out in a very short time. Dr. Toogood (to whom I am indebted for this case) tells me that at various periods this patient has had patches of erythema in various parts of the body, following or associated with the crises. The complete loss of sensibility to all forms of painful stimulation in the left leg, coupled with the fact that this is the only part of the body in which she does not suffer pains during the crises, suggests the probability that the third, fourth, and fifth lumbar, and the first and second sacral roots are destroyed, and probably also the association neurones of the substantia gelatinosa in these segments.

Case 43. Male, aged 37, with definite history of syphilis at the age of 21, for which he was treated eighteen months, came to me with paralysis of the right external rectus, Argyll-Robertson pupils, pains in the legs first felt three years ago, history of several gastric crises, knee-jerks present and exaggerated, no Romberg symptom, no ataxy, no girdle sensation, no bladder troubles. Eighteen months later was seen again suffering with pains in the legs. There is no external rectus paralysis, knee-jerks exaggerated, still in preataxic condition. A little later I discovered for the first time a patch of anaesthesia corresponding to the posterior branches of the fourth and fifth dorsal roots on the right side. The anaesthesia came on after a series of gastric crises with local pains. Three weeks later he again suffered with an attack, and upon subsequently testing the cutaneous sensibility I now found a complete belt of cutaneous anaesthesia corresponding to the fourth and fifth segments and as represented in the above charts (Fig. 34). The presence of the knee-jerks and the absence of ataxy in gait and station is due to the fact that the disease has not yet sufficiently affected the lumbo-sacral roots; this also accounts for the absence of bladder troubles.

Case 44. Female, aged 46. No direct history of syphilis; one miscarriage; one child lived only a few months. Brother died of general paralytic tabes. Symptoms began with gastric crises five years ago (note the broad belt of loss of sensibility in the thoracic region indicating advanced root destruction).

Present state. She can now get out of bed, but is unable to walk or stand without support, but she can wash and feed herself. The muscles are not wasted, there is marked hypotonus in both legs, deep reflexes of upper and lower limbs lost, superficial reflexes absent on right, just present on the left side; epigastric, present on the right, absent on the left, frequently bilateral response to right-sided stimulation. Hyperaesthesia of skin over the right side (vide Fig. 35). There is a good deal of ataxy in the hands; she complains of great pains, shooting and darting in character, in the right infrascapular region. On moving, the pain was greatly aggravated, no friction was detected, although she thought she was suffering from pleurisy; pain is in the

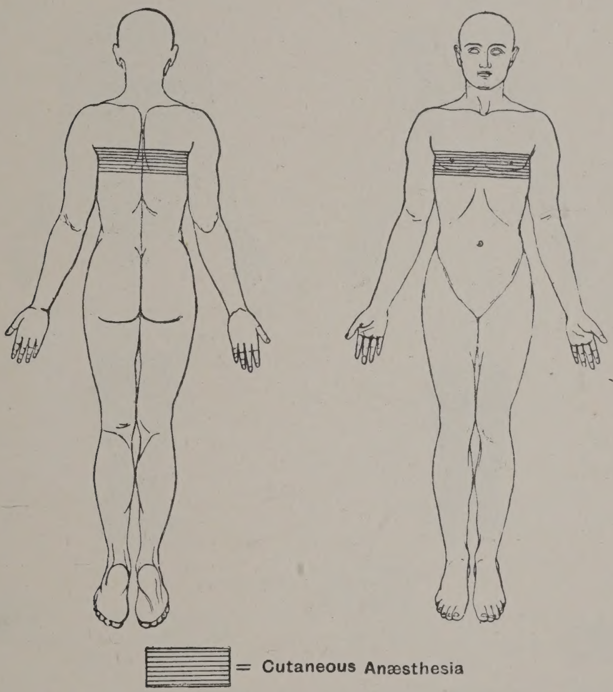

Fig. 34. Chart of Case 43 in Pre-ataxic Stage.

region where hyperaesthesia is indicated in the chart. Joint sensibility lost in all joints of the lower limbs and in the fingers of the upper. She has lost sensation in the ring and little fingers of the left hand within the last three months. She first became aware of this by a cramp-like feeling. She complains of a deep-seated burning pain in the epigastrium, but *she does not now have gastric crises.* Pupils, right 5 mm., left 3½ mm., Argyll-Robertson; complains of dimness of vision.

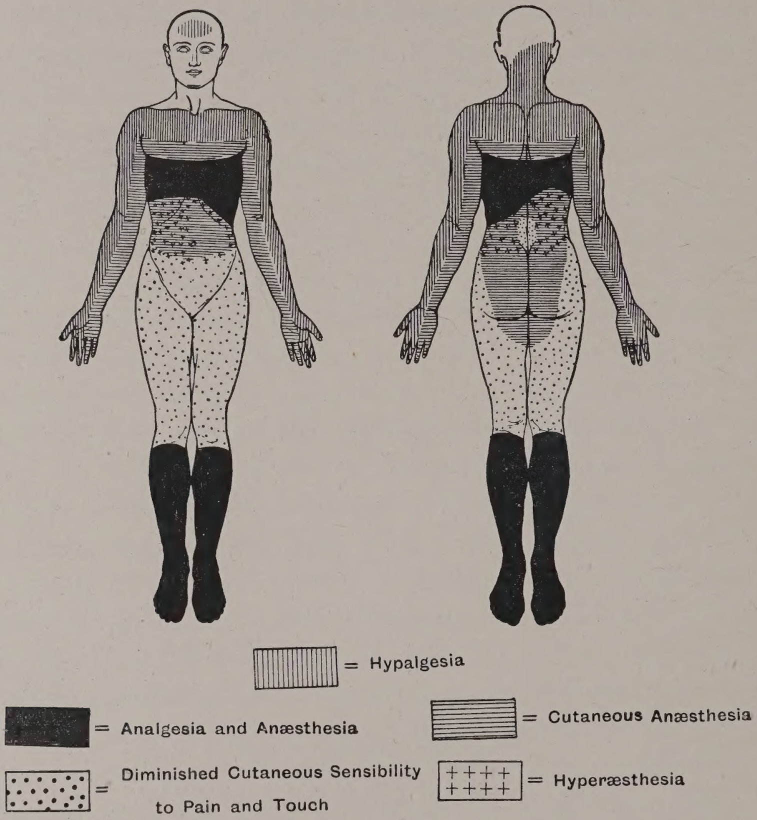
= Hypalgesia
= Analgesia and Anæsthesia
= Cutaneous Anæsthesia
= Diminished Cutaneous Sensibility to Pain and Touch
++++
++++
= Hyperæsthesia

Fig. 35. Chart of Case 44.

Case 45. R. D., aged 38, carpet planner, admitted for unsteadiness in walking, shooting pains in legs, and tightness round the waist.

Family history. Nil noteworthy, no neuropathic heredity.

Personal history. Married fifteen years. His wife has had nine children, six of whom are living.

Previous illnesses. Syphilis two years before marriage, seventeen years ago suffered with hard chancre for which he was treated for two months. Patient has led a hard life, he has been a carpet planner since he was 20 years of age. Moderate alcohol.

Present illness. Began about a fortnight after recovery from influenza, January, 1900, by shooting pains in both legs and pain in the head of a morning. Between the attacks of pain he noticed numbness of the legs, and felt as if he were walking upon felt. He commenced to be unsteady in his gait, and frequently pitched forward as if his knees had given way. About this time he had very little power in retaining his urine, which would dribble away unless he frequently relieved his bladder. One month after the onset of the first symptoms, patient felt a numbness in the anal region, and he became very constipated; had also pain in the perineum, especially when he micturated. Feeling of constriction round the lower part of the abdomen

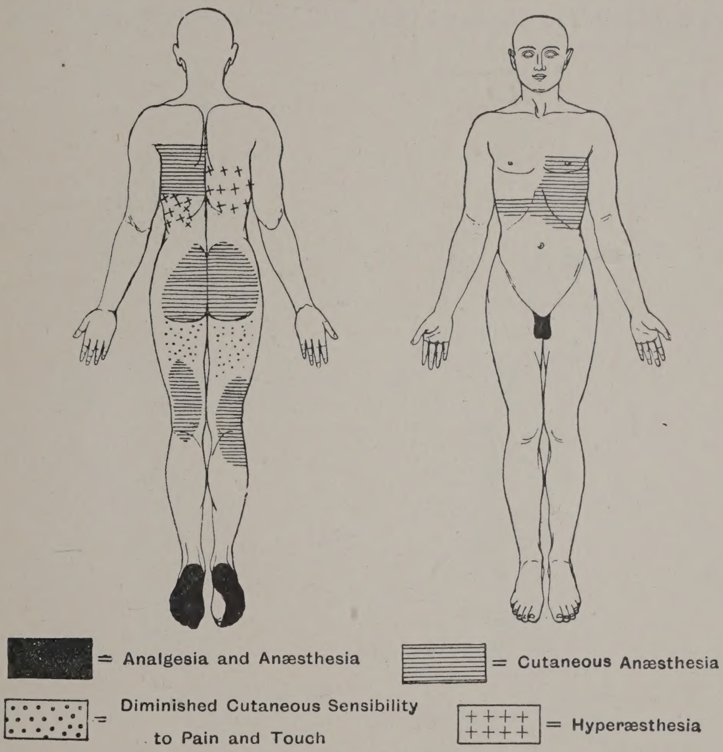
= Analgesia and Anæsthesia
= Cutaneous Anæsthesia
= Diminished Cutaneous Sensibility to Pain and Touch
++++ ++++ = Hyperæsthesia

FIG. 36 A. Chart of Case 45.

for the last six years, not worse lately. No gastric, laryngeal, or nephritic crises. Muscular power unimpaired, some hypotonus of hamstring muscles. Sensation—Considerable impairment of tactile and painful sensations in regions indicated in chart, but thermal unimpaired (Figs. 36, A and B). Very slight inco-ordination of upper and lower extremities, he is very weak, however, through muscular wasting and weakness. He is *much emaciated*, the feet are very cold and in a position of talipes equino-varus; they are cyanosed, and the skin smooth and glossy. He is unable to turn himself over in bed, and is quite helpless. All the deep and superficial reflexes are lost in the limbs, and there is marked hypotonus. He has no joint sensations, and he cannot tell the position of his limbs. There is a complete loss of sexual power and this may be correlated with insensibility of the testicles to pressure and anaesthesia and analgesia of the external genitals.

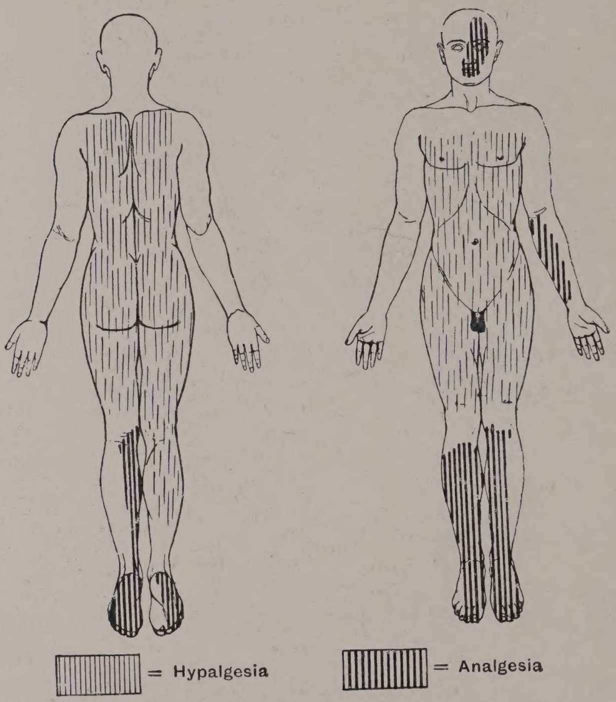

FIG. 36 B. Chart of Case 45.

Thermo-anaesthesia. This was not met with nearly as often as affections of light tactile sensations. Regions which were insensitive to pricking or touching with the tip of the finger generally appreciated heat and cold; but very frequently the tube containing hot water could not be distinguished from that containing ice-cold water, and in advanced cases both were said to have caused a pricking or burning sensation. Delay in response was frequent in all forms of sensory disturbance. This was generally in proportion to the intensity and extent of the anaesthesia. In advanced cases also, if the patient felt the stimulus, it was wrongly localised.

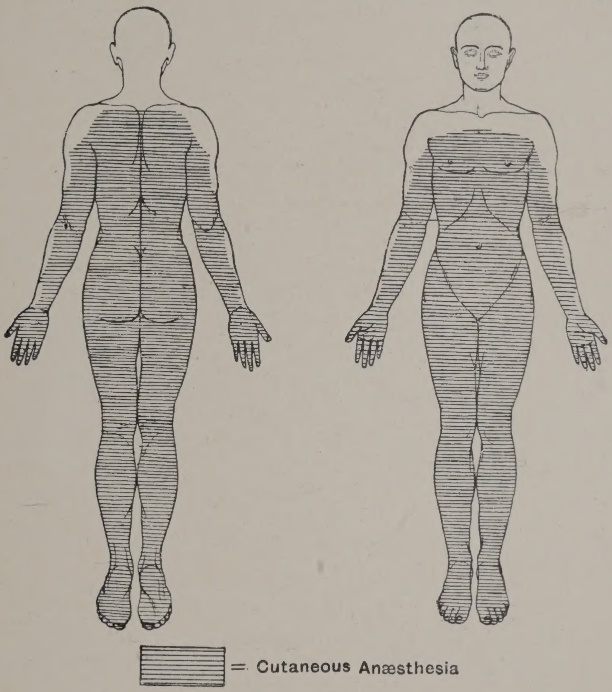

Fig. 37. Chart of Case 46.

Case 46. The three charts, 37, 38 and 39, were obtained from a man aged 52 in the final paralytic stage of tabes; he was very wasted. The loss of sensibility was so profound that he did not know whether there was anything in his hands or not when it was put there, and the only way he knew was to put the object up to his lips and feel with this sensitive part of his body. Thus I put the percussion hammer in his hand, made him clench his fingers (he held it between the ring and middle fingers with the fist closed), but not till he had put his lips to it could he tell me that it had a stem. He is absolutely blind, right pupil 6 mm., left 5 mm., cataract right eye, both pupils inactive to light and pain, and hardly any movement on convergence. On being told to lift up his left hand and look towards it, the right eye remains immobile. The left moved towards it, and then immediately swung back by oscillations to the straightforward position. The patient thought that he was directing his eyes to the hand all the time. There was extreme hypotonus of the muscles of the limbs.

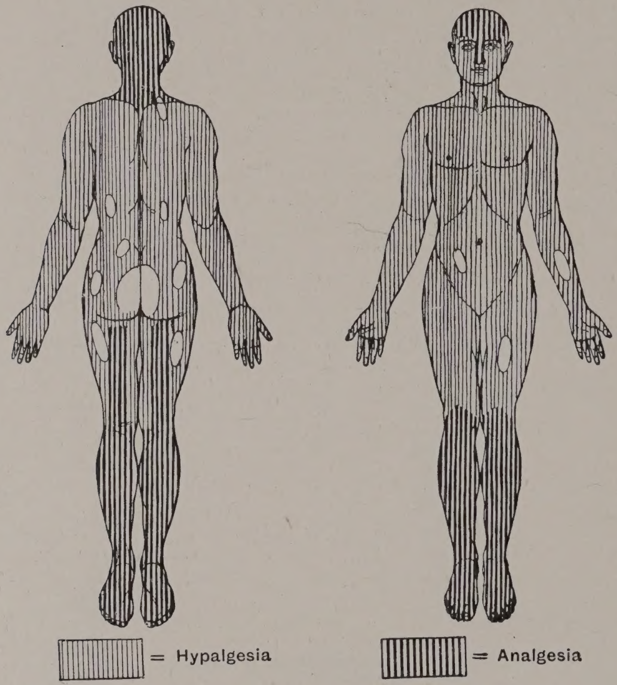

FIG. 38. Chart of Case 46.

Accompanying the diminution or increase of sensitiveness there may be various changes in the sensation produced. There may be a marked delay in the perception of pain; thus the prick of a pin may be felt at once, but the pain only after an interval of time, also a delay greater than normal may attend the sensation of heat. The power of localising a sensation may be strangely altered. The sensation, for example, may be referred to the other limb, sometimes in a similar position—‘allochiria’, and in a few instances to a point of the skin above the next joint higher up in the limb. A stimulus which was not at first felt may subsequently provoke a response by repeating it a few times, thus illustrating the effect of summation. A prick in one spot may be felt in many places (polyaesthesia) on both legs.

Ulnar sensation of Biernacki. In many cases it was found that compression of the ulnar nerve at the elbow produced no tingling or pins and needles in the fingers ; it must, however, be remembered that in many normal people one cannot sufficiently compress the nerve to produce pain.

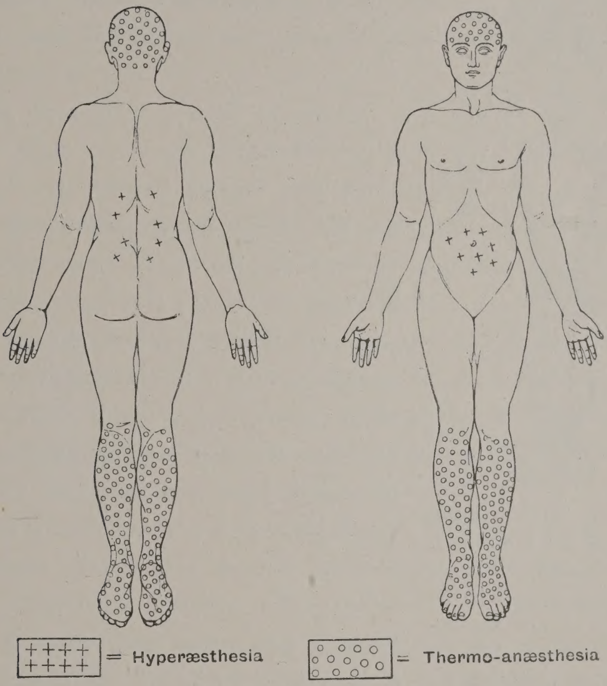

Fig. 39. Chart of Case 46.

Insensibility to pressure of testicles. In some cases pressure of the testicles produced this sign, which is undoubtedly a useful one, and is associated with impotence.

Egger's test of vibration of tuning-fork on bone. A tuning-fork placed on the bone may cause no sensation of its vibration in tabetic patients, indicating a break in the path of conduction of the sensory impulse from bone. This sign may be observed in patients who are in the second or third stage of the disease. Cases in the preataxic stage may not yield this sign, but I have ascertained in one case that a diminished sensibility may exist very early, and be unequal in the two legs.

The following case illustrates this phenomenon :—

Case 47. C. A., aged 37, a married woman, came to the Obstetric Department of Charing Cross Hospital, and was sent on to me.

Personal history. Married at 17 to a retired naval man; an eight months' child born, which lived only two days. She found that her husband suffered with venereal disease, she had a sore throat and her hair came out; she therefore left him. After his death, she married again at 22 a retired soldier. Miscarriage four months after marriage, leaving her with uterine disease. Subsequently she suffered from ulcerated legs, and had two more miscarriages. She noticed first a feeling of a cord round the waist, then rectal crises; she suffered with difficulty in holding her water two years ago; for twelve months pains in the legs and body, and progressive difficulty in walking, also frequent attacks of giddiness and flatulent eructations with gastric distension.

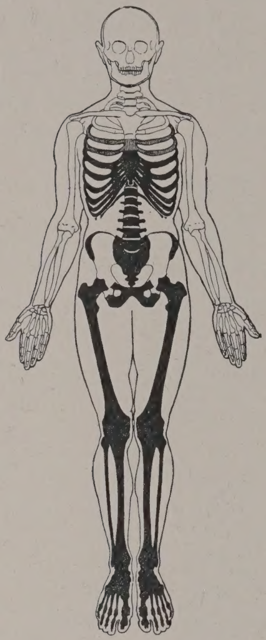

Fig. 40. To show loss of bone sensibility in Case 47. Black indicates the bones which are insensitive to the vibration of the tuning-fork. The third and fourth ribs were not absolutely insensitive. In distribution the loss of bone sensibility in this case corresponded pretty closely with the cutaneous anaesthesia.

Physical signs. Pupils equal, small, Argyll-Robertson; absence of deep reflexes, plantar reflexes lost, epigastric just present, cutaneous anaesthesia from fourth to tenth segments inclusive, anaesthesia and paresthesia of soles of the feet, analgesia or hypalgesia to pricking of legs, and of the thorax from fifth to ninth segments, with some hyperaesthesia above and below. Marked inco-ordination and wasting of legs, no inco-ordination in hands. Marked hypotonus of hamstring muscles.

Two years later she became quite helpless, the cutaneous disturbances had become more marked. Slight contraction of field of vision, and pallor of disks. Retching attacks without vomiting, accompanied by epigastric pain. Foot drop from paralysis of dorsal flexors, some inversion of soles, especially of right foot, from peroneal paresis. Loss of bone sensibility, as shown in the above chart (Fig. 40). She is now very depressed because she fears she may give her husband the disease. She has attempted suicide.

Visceral Disturbances

The especial frequency with which the mid-thoracic and lowest lumbar and sacral roots are affected in the early stages of tabes serves to explain the frequency of bladder troubles and gastric crises. Figure 41 will help to explain visceral crises in connexion with cutaneous anaesthesia; for it will be observed that when the posterior roots supplying the skin of the mid-thoracic region are irritated by the morbid process causing their destruction, the same process will affect the segmentally correlated visceral afferent roots.

Bladder troubles are among the earliest and most constant symptoms of tabes; they are not severe, and the patient frequently fails to seek advice for this reason; for the majority of the cases that come to the hospital do not, in my experience, seek relief especially for bladder troubles; it is only as the result of inquiry, as a rule, that the patient, in relating his symptoms, mentions difficulties in starting micturition or holding his water. When asked if he has noticed any difficulty with his water, the patient will tell you either that he has a difficulty in starting the stream, requiring a strong voluntary effort on his part, or that it lacks force, and takes him some time to empty his bladder; in the later stages he does not empty the bladder completely, consequently he frequently suffers with residual urine, and catheterization is necessary. This condition indicates lack of power in the detrusor urinae, whereas another frequent condition met with indicates loss of reflex tonus in the sphincter; for a cough, laughing, or any cause leading to increased intra-abdominal pressure, suffices to cause the escape of a little urine into the urethra, followed by the urgent desire to micturate. Imperfect contraction of the bladder even when not very marked may lead to serious complications, for residual urine tends to decompose and gradually induces over-distension; cystitis results and secondary infection of the kidneys may develop insidiously; and even when difficulty of micturition has been apparently slight and therefore unheeded may lead unexpectedly to a fatal termination.

Slight intermittent febrile disturbances should always put one on guard concerning decomposition of residual urine.

Bladder crises have been described, but they are rare. I have not met with a case. They consist of violent pains which occur in the lower part of the belly radiating to the urethra, and the inner side of the thigh. The patients have an urgent desire to micturate, but are unable; they experience the most severe burning and cutting pains in the urethra, and these may be associated with lancinating pains throughout the lower extremities. These crises may last a few or many hours.

In about 65 per cent. of the cases which I observed there was a history of bladder troubles; this is much too few. The disparity with the results of Leimbach's analysis of Erb's patients (80 per cent. bladder disturbances) may be accounted for by the fact that in out-patient practice in London many of the cases are seen only a few times.

In the tabo-paralytic cases, bladder trouble, apart from the incontinence of dementia, was only discovered in 60 per cent., probably again much too few, for examination of the spinal cords in a number of these cases showed that the lumbo-sacral segments of the cord were always affected to some degree by the degenerative atrophy.

Renal crises have also been described; they simulate renal colic; but some of these cases may be due to the passage of a stone or gravel in a patient suffering with tabes.

Gastric crises. In twenty-one patients out of sixty (36 per cent.) gastric crises occurred, and they were not infrequently the earliest symptom of the disease, as the attacks of pain and vomiting were the sole cause for which the patient sought relief.

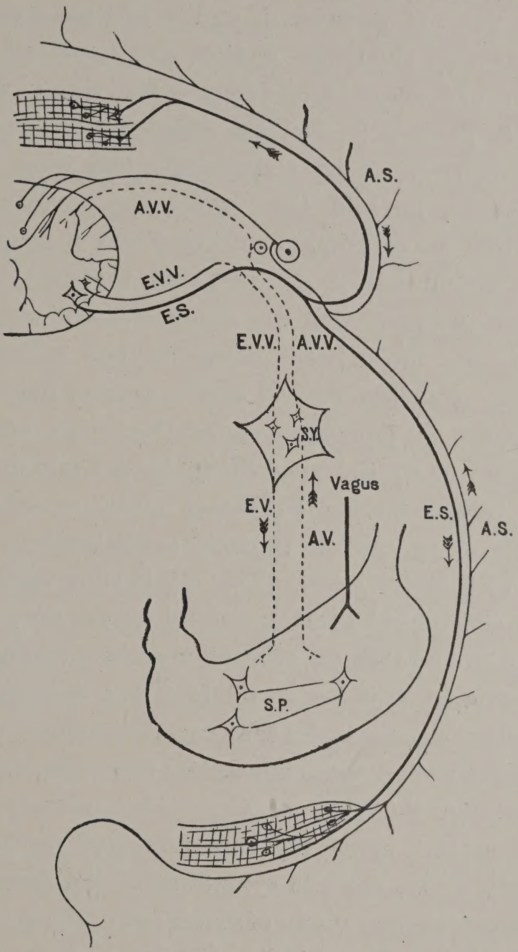

Fig. 41. Diagram to show somatic and splanchnic nervous structures in the seventh thoracic metamere. The correlation of the skin and muscle in the protective reflex is indicated.

E.V.V. = Efferent splanchnic; E.S. = Efferent somatic; A.V.V. = Afferent splanchnic; A.S. = Afferent somatic; S.P. = Plexus of Auerbach and Meissner; E.V. = Efferent visceral from sympathetic ganglion; A.V. = Afferent visceral to sympathetic ganglion.

The coarse and fine fibrils which exist in both somatic and splanchnic nerves are not differentiated.

In one case the patient was admitted for intestinal obstruction, and the surgeon was sent for with a view to operation.

I have seen a case in which visceral crises were very severe, and tabetic symptoms so ill-defined that although the patient was seen by several distinguished physicians, the true nature of the disease was not discovered, and a surgeon was called in, who performed an abdominal section, and found all the organs normal. He had absent knee-jerks at the time; it would be interesting to know if he had not Argyll-Robertson pupils and thoracic anaesthesia, as he undoubtedly had when I saw him later. Moreover, he said that before the operation his legs had given way on occasions, and symptoms pointing to rectal crises were recounted. I am informed that the reason why the operation was performed was the existence of pus and blood in the urine on intermittent occasions, plus a large movable kidney. The symptoms seemed also to suggest pyloric disease.

In all cases, as previously stated, the crises are associated with complete or partial anaesthesia in the mid-dorsal region, and often with persistent subjective girdle sensation, but by no means is every case of thoracic anaesthesia in this region associated with gastric crises. This would show that if the crises are due to affection of afferent visceral nerves they are affected independently, and that the relative frequency and early appearance of gastric crises is due to the fact that they or their intraspinal terminations are under the same determining contributory factor to degeneration as the intraspinal terminals of the posterior roots supplying the skin of the mid-thoracic region. One intelligent patient under my care remained in the preataxic stage twenty years, the sole symptoms of the disease of which he was conscious being attacks of severe pain, 'sharp' in character, which extended both vertically and transversely between the shoulder-blades and over the whole back; as soon as the pain became acute, vomiting would take place and relief would come. He had no pains in the region of the epigastrium, the attacks of vomiting would last three or four hours.

The attacks of vomiting may be preceded by a pain or a feeling of weight at the epigastrium, in one patient the vomiting was preceded by intense occipital headache, and a feeling of distension of the stomach, and this was followed by lightning pains through the whole body, except the face and the leg which was analgesic and anaesthetic. Severe attacks may last several days, the patient vomiting the contents of the stomach, whatever they may be, and the retching continuing with short intervals, just as in sea-sickness or cerebral tumour, only mucus or watery mucus frequently mixed with bile being voided. In severe cases, the patients have occasionally vomited coffee-ground material, or blood, due probably to rupture of congested vessels. The patients suffering with severe attacks are quite unable to retain food or even water in the stomach, and the pains may be so agonizing that they shriek out. The tongue is dry and furred, the lips parched with thirst ; worn out with the want of sleep and the distressing symptoms, it is remarkable how soon they recover when the attacks cease. Indeed it is not uncommon to find a patient enjoying a hearty meal a short time after the vomiting ceases. Chemical analysis of the gastric secretion has given variable results, but generally the acidity is diminished.

Occasionally patients suffer with incomplete gastric crises in which there are merely paroxysms of cramp-like pain of the stomach, or only eructations and vomiting without pain.

A patient of mine suffered for years with ‘ rheumatic pains ’ and ‘ indigestion ’, for which he was treated at several hospitals without relief. After three years he had delusions of persecution, that unseen agencies turned on electricity and blew up his stomach, and he was admitted to an asylum where his ataxia and progressive dementia were observed. Post-mortem examination of the spinal cord showed the typical tabetic lesion, and there is no doubt that he suffered with modified gastric crises.

Cases of gastric crises are occasionally accompanied with frequent purgations. I have not personally met with any attacks of the intestinal crises which have been described as occurring occasionally. They are said to be unaccompanied by pain ; apparently suddenly and without cause, frequent watery evacuations of the bowels take place for days, weeks, or months, and then cease as suddenly as they appeared. *Rectal crises*, however, are not so rare ; they were met with in 8 per cent. of cases, and like gastric crises were among the early symptoms. The patients complain of tenesmus, and urgent desire to go to stool, of severe pain in the back passage like the introduction of a hot iron ; sometimes this is accompanied by tenesmus and straining, and it is said evacuations of blood and slime may be passed. Much more frequently the patients suffer with constipation and difficulty of relieving the bowels without purgatives. Not infrequently they are unable to keep themselves clean. This is especially the case when they have to start micturition by strong voluntary pressure of the abdominal muscles ; faeces are then apt to escape owing to some loss of the reflex tonic contraction of the sphincter ani ; moreover, they cannot always tell when defaecation is complete.

Dr. Byrom Bramwell recently exhibited an unusually interesting case of tabes in an unmarried man, aged 30 years. He had contracted syphilis when 23 years of age ; ten months after the primary sore the first symptoms of tabes showed themselves as gastric crises and these had persisted ever since. A year later dimness of vision and lightning pains were complained of, and when 26 years of age bladder and rectal disturbances appeared. His vision became entirely lost eighteen months ago and during this period he had become profoundly ataxic. Charcot's joint disease was well marked in the right knee and to a lesser extent in the left knee. There had been no amelioration in the condition, the gastric crises and lightning pains being still as severe as ever. There was great inco-ordination of movement on attempting to walk, the legs being thrown up violently, and the patient appeared simply to be kicking the air.

The unusually early development of tabes was the remarkable feature in this case ; which is also of interest in showing that the most vulnerable part of the spinal cord is the mid-thoracic region, *for gastric crises* occurred within ten months of the primary sore.

Laryngeal symptoms. Laryngeal crises after those of the stomach are the most common, and their characters vary considerably. Graeffner has recently written a monograph on tabes in especial reference to laryngeal symptoms in 226 cases. He divides the disturbances into two groups : (1) paresis or paralysis of the vocal cords, which were met with fifty-four times, (2) crises twenty-six times and parakineses twenty-eight times. Thus eighty-eight tabetic patients were affected with laryngeal troubles ; in some paralyses were associated with crises. These statistics were based upon observations made upon patients who had been in the hospital from one to three years. The total percentage with laryngeal symptoms was 42·7 per cent., and this percentage increased with the length of time the patient had been in the hospital. He regards vocal cord tremor as an important sign of tabes because it occurs in no other organic disease of the nervous system to anything like the degree that it does in tabes. He agrees with Dorendorf in explaining it as the first expression of the disturbance of harmony of antagonistic groups of muscles. This tremor is the rudimentary form of the laryngeal crisis and due to overaction of the adductors. The commonest form of laryngeal crises is due to adductor spasm overcoming the weaker abductor, and the symptoms may resemble whooping-cough or laryngismus stridulus. There is a true laryngeal spasm with noisy inspiration and expiration, cough, and often marked dyspnoea. The introduction of a sound into the larynx or external pressure of the superior laryngeal nerve at its entry into the larynx will sometimes bring on an attack. Sir William Gowers states—‘ that in one recorded case the spasm spread to the pharynx, making swallowing impossible ; a violent attack extended to the muscles of respiration and the patient died asphyxiated. Death from these attacks is, however, rare.’

The following case illustrating laryngeal symptoms is of interest :—

Case 48. A groom, aged 29, was admitted under my care at Charing Cross Hospital, May 27, 1909. He had been attending the out-patient department for eleven months, and it was at one time thought that he was suffering with aneurysm. He complained of hoarseness and shortness of breath whilst speaking. This became progressively worse, and he felt as though he could neither get sufficient air during inspiration, nor swallow properly. Three months ago he began to be troubled with suffocating attacks during the night ‘ being awoke from sleep by a sensation as of worms gnawing at the throat, and a feeling of intense suffocation which caused me to jump out of bed fighting for breath ’. He usually regained breath in a few seconds with a crowing inspiration.

The vocal cords on examination were practically immobile, the right moving only slightly and there being a chink of less than $\frac{1}{32}$ inch between them. There was well-marked abductor paresis. The soft palate also showed some paralysis.

History. Six years ago he acquired syphilis for which he was treated ten months. A year later he married. His wife had a rash on her back. Her first miscarriage was twelve months after marriage. Her second miscarriage was twelve to eighteen months after marriage. Her third miscarriage was eighteen months ago. *There has been no living child.* Twelve months ago the patient had difficulty in micturition; for three months he has had *a stiff neck* and running at the nose, he has *sharp shooting pains in the legs* and tingling in the fingers, also he feels the 'jarring of the ground in walking'.

Physical examination. Retinae show some early optic atrophy. Pupils unequal. Left larger than right. Right a little irregular. Neither react to light. Both react to accommodation. Knee-jerks exaggerated. Achilles jerk greater on right than on left side. Lumbar puncture was performed. Cerebro-spinal fluid contained sixty leucocytes to the cubic centimetre, of which 90 per cent. were lymphocytes in a more or less degenerated state. A sample of blood and cerebro-spinal fluid both gave a positive antibody reaction by the Wassermann test.

Bronchial crises have been described as paroxysms of rough, hard cough sometimes ending in a 'whoop'; such attacks of paroxysmal cough are more frequent than definite laryngeal spasm; they frequently occur in the early stages of the disease, but definite crises of laryngeal spasm may also be among the early symptoms and not infrequently they are associated with gastric crises. As Graeffner has shown, laryngeal crises are a frequent affection and the symptoms are alarming. Graeffner observed the interesting fact that the upper part of the trapezius was diminished in size in 25 cases out of 113 examined, and 11 of these were associated with laryngeal paralysis and 4 with tremors. These facts show an affection of the spinal accessory nucleus or nerves to account for the laryngeal paralysis and the wasting of the trapezius.

An increased frequency of the pulse is usually associated with laryngeal crises, and anginal attacks have been described; but arterio-sclerosis, aortic disease, and aneurysm are relatively common in tabes. 'Strümpell, in a very interesting communication on the subject of the association of disease of the heart and vessels with tabes, thus states his conclusions: (1) it is not an uncommon event to find aortic insufficiency, sclerosis of the aorta, and aneurysm, associated with tabetic phenomena both rudimentary and well developed; (2) it is frequently found that vascular changes are associated with marked symptoms of tabes; (3) these frequent combinations of arterio-sclerosis and tabes indicate a similar causation; (4) the existence of a single tabetic symptom in association with arterio-sclerosis, especially Argyll-Robertson pupil phenomena, may be considered proof of a syphilitic origin. I have a case now under my care of aneurysm of the abdominal aorta, the only sign of parasyphilis being the Argyll-Robertson phenomenon.

Genital organs. Impotence may be an early or a late symptom. It may be preceded by satyriasis. In some cases impotence is associated with anaesthesia of the external genital organs; in some it is associated with atrophy of the testicles. Diminished sexual power occurred in very many of the cases, and absolute loss of sexual power in, at least, 16 per cent.; this, too, may be an early or late symptom. Increased sexual desire is pretty frequent in the early stages of general paralysis and in the tabetic form of the disease. It may lead to criminal offences (vide p. 266).

Atrophy of the testicles is of frequent occurrence in general paralysis, and, generally speaking, the testicles lose weight out of proportion to other organs. The satyriasis in a tabo-paralytic may be associated with delusions of extraordinary sexual power; there is often marked desire, but no ability to perform the sexual act. Such patients may be taken up for indecent exposure and assaults on young children.

Clitoris crises occasionally occur in female tabetics: a patient of mine suffered with pruritus of the genitals and this led to her rubbing the parts, causing painful erections of the clitoris. Tabetic pruritus ani is an early symptom and is generally paroxysmal.

Locomotor Disturbances

Sense of position of joints. The sense of position of joints was tested in 30 successive cases, and in 7 no appreciable affection was shown. All of these 7 were early cases, and the diagnosis of tabes was usually based on other evidence than ataxy, viz. Argyll-Robertson pupils, lancinating pains, optic atrophy, visceral crises, and trunk tactile anaesthesia. In none of these 7 cases was there any appreciable disturbance in cutaneous sensibility of the limbs. In 4 very pronounced cases of Charcot's knee-joint, there was no loss of sense of position discovered in the toes; but one of these had impaired cutaneous sensibility to pain and touch in the legs. There was usually a distinct correlation of loss of sense of position of the joints and the degree of ataxy, also between the disturbance of cutaneous sensibility and the joint sensibility. Thus, in one case of arm tabes, there was loss of joint sensibility in the arms, especially the right, in which the disturbance of cutaneous sensibility was most marked. In 21 out of 30 cases examined, loss of joint sensibility was found in the toes. In 11 the sense of position in the joints of the whole lower extremity was affected, but 9 of these cases were in the third paralytic stage, and there was a correlated loss of sensibility to touch and pain, and in some cases also marked thermo-anaesthesia. In 9 out of 30 cases the joint sensibility in the upper limb was affected, and in all cases accompanied by disturbance of cutaneous sensibility, especially of the post-axial border of the limb. In 3 very advanced and prolonged cases of ataxy, the joints of all the limbs were affected; in the others it was only the fingers (especially the ring and little fingers), or the fingers and the wrist-joints. In one case of fairly complete loss of joint sensation of the upper limb there was only moderate disturbance of cutaneous sensibility. The joint sensibility was lost in the hand on the right side in one case where the loss of cutaneous sensibility was most pronounced. The conclusion arrived at is that loss of sense of position in joints is a very important factor in the production of inco-ordination of movement; it is associated usually, but not necessarily, with loss or disturbance of cutaneous sensibility.

The fact that the toes and fingers are affected first, then the ankle and wrists, and later the joints above, agrees with the distribution of objective sensory disturbances. No doubt the proto-neurones, subserving cutaneous and joint sensibility, are quite independent structures; but, as a rule, they are simultaneously affected. I believe this sense of position of joints is due to a complex group of sensations arising in alterations in *tension of structures about joints*, rather than in the alteration of contact of surfaces such as Professor James assumes to be the case in judging the sense of position of limbs. It may be pointed out that no one has demonstrated nerve-endings in articular cartilage; there are, however, nerve structures in the synovial membrane and capsule of the joint, in the tendons, muscles, and fibrous structures. The most important nerve-endings are undoubtedly the Pacinian corpuscles, which are especially constructed so as to be influenced by alterations of tension and pressure in the deeper structures. In support of this argument is the fact that arthropathies may occur without loss of sense of position and without ataxy, although I have not met with a case in which sense of position of the joint was lost without ataxy. The joint sensation is tested by obstructing the vision of the patient, the joint is then moved and he is asked what has been done. In ataxic patients, the sense of position of the great toe is frequently lost and even the larger joints may be lost in advanced cases.

I have met with cases of ataxy without loss of sense of position of the joints, even of the toes, and several tabo-paralytics, who were able to give reliable answers, showed the early symptoms of ataxy without loss of joint sensation.

Deep reflexes. As Westphal first pointed out, loss of the knee-jerk is one of the earliest and most constant symptoms of tabes; it may be absent on one side and present on the other. The loss often precedes for years the ataxy. Sometimes it may be elicited by Jendrassik's method of reinforcement. The patient is told to look at the ceiling and pull with the hands clasped. In 7 of my cases, not tabo-paralytics, nor with cerebral lesions, the knee-jerks were present on both sides. In 3 the knee-jerk was present on one side and absent on the other ; that is to say, absent knee-jerks were found in less than 70 per cent. of my cases when first seen, but then a considerable number of the patients were in the preataxic stage ; in fact all the 10 cases, except a case of arm tabes, were in the preataxic condition, most of them suffering with optic atrophy or other ocular troubles ; two came with gastric crises. In two cases the knee-jerks disappeared first on one side then on the other, after a series of attacks of lightning pains in the legs. When the knee-jerk is present on one side and absent on the other, it is suggestive of associated brain trouble, and the possibility of tabo-paralysis must be considered.

The triceps jerk is absent when the knee-jerk is absent, although there might be no other symptoms affecting the arm. In some cases, however, it is present when the knee-jerk is absent ; it undoubtedly disappears later than the knee-jerk. The tendo-Achillis reflex may be obtained by making a patient kneel on a chair in such a way that the tendon can be struck ; absence of the reflex contraction is usually observed ; sometimes this reflex cannot be obtained when the knee-jerk can, and the converse. In tabo-paralysis the knee-jerk may be present on one side and absent on the other, and when I find this condition in a patient exhibiting well-defined symptoms of tabes dorsalis I always apprehend the possibility of the existence of mental symptoms or their development in the near future. Occasionally, as Hughlings Jackson showed, the knee-jerk may reappear after an attack of hemiplegia. In tabo-paralytic cases I found the knee-jerks were absent on both sides in 77 per cent., absent on one side in 16·7 per cent., present on both sides in 7 per cent. I have often noticed that with the onset of mental symptoms the inco-ordination of gait and station and the hypotonus seemed to be less marked. As the brain becomes affected the characteristic ataxy may give place to a shambling shuffling gait. In one case I observed the knee-jerk return on the side upon which a number of epileptiform convulsions occurred; in tabo-paralysis the fits may in rare instances be followed by the appearance of Babinski's sign, and yet the knee-jerks remain absent. I have found that both the conditions above described have been associated with a well-marked degeneration of the crossed pyramidal tracts.

Tonus. A more or less marked diminution of muscular tonus occurs in all cases of tabes dorsalis with the occasional exception of cases in the preataxic stage. There is usually a distinct relationship between the degree of hypotonus and the ataxy of the limbs, and if there is a difference in the ataxy of the two limbs it is observed that the hypotonus is more marked in the more ataxic limb. The degree of loss of tonus may be estimated by Fränckel's method. The patient is laid flat on the back on the bed and told to keep one leg on the bed fully extended at the knee, the other is raised with the knee extended; in the healthy person in whom there is normal tonus in the hamstring muscles the limb cannot be raised to a right angle with the body; when there is impairment of the normal tonus it can, and in advanced cases of tabes, especially when they have advanced to the bed-ridden stage, the hypotonus is so great in the hamstring muscles that the limb can be flexed at the hip to such a degree that the toes may be made to touch the forehead. As the muscles in this stage all react normally to the constant and faradic currents, the hypotonus is due to the absence of the afferent stimuli; we have therefore a condition of sensory paralytic ataxy much the same as Sherrington and I produced in monkeys by division of all the posterior roots of a limb; one of the most striking effects of the experiment was the great loss of tonus that was immediately produced upon section of the roots. Improvement of the tonus of the muscles may be brought about by massage and exercises directed by vision, and this seems to show that the hypotonus is due to two causes: (1) the absence of the sensory stimulus by the destruction of the posterior roots, (2) a disuse atrophy of the muscles and impaired nutrition; the latter is capable of improvement by the treatment mentioned; the former is irremediable. Another evidence of hypotonus of the hamstring muscles is afforded by keeping the thigh and knee flat on the bed with one hand and raising the foot with the other ; according to the loss of tonus the heel can be raised from the bed (vide photograph). The sudden giving way of the legs, not infrequently met with even early in the disease, may be due to an exhaustion of the tonic contraction of muscles.

One of the earliest paralytic signs of tabes is a loss of tonus in the dorsal flexors of the foot and foot-drop while the patient is lying on his back in bed. This is aggravated by the effect of the constant weight of the bedclothes, which should be remedied. When such a patient is told to flex rapidly his hip to the uttermost, it will be observed that the synergic dorsal flexion of the foot with hip and knee does not take place. By the aid of vision and attention he can produce flexion, but it involves continuous attention, and even then it is not synergic but *follows* the flexion of the hip.

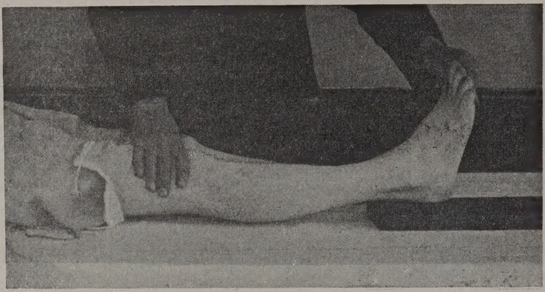

FIG. 42. Photograph of the leg of a patient showing hypotonus of the hamstring muscles. The heel has been raised, and a piece of wood can be pushed under on account of its being raised from the bed, while yet the knee is flat on the surface.

DISEASES OF THE BONES AND JOINTS

Arthropathy and bone affections occur relatively frequently in cases of tabes. [See also ‘System of Syphilis’, vol. ii, pp. 54 and 59, also pp. 16–43.] I have met with them oftener in women than men, and not infrequently associated with gastric crises. Spontaneous dislocation or fracture may be the cause of the patient seeking medical or surgical advice. Joint affections and spontaneous fractures may be met with not only in hospital, but also asylum cases. It is of considerable importance to bear this in mind, otherwise officials and attendants might be charged unjustly with neglect or ill-treatment, when in reality a very trivial accidental injury or no real injury, merely turning the patient in bed, might be followed by spontaneous dislocation or fracture in asylum cases of tabes or tabo-paralysis. Not long since I saw a fracture of the thigh in a young man suffering with juvenile tabo-paralysis ; the spinal disease was not discovered during life, but microscopical examination of the cord showed the characteristic lesion. It would have been easy to have cast blame in such a case as this, for the immediate cause of death was due to infective suppuration around the seat of fracture. Such fractures may occur apparently spontaneously or as a result of a very slight injury, or even a false step ; they are usually quite painless, and one patient told me she did not know her leg was broken until she saw the ends of the bone sticking up. A considerable number of women in workhouse infirmaries lie there incapacitated for numbers of years with tabetic joints. One of the earliest cases reported by Dr. Buzzard is still in the St. Pancras Workhouse, where she has been nearly thirty years ; the gastric crises and lightning pains, from which at one time she suffered excruciating agony, have latterly almost ceased. The joint affection may be the sole symptom causing the patient any trouble ; for of course the physical signs, namely, the existence of the Argyll-Robertson pupils and absent knee-jerks, would be unknown to the patient, and if there were lightning pains, they would be put down to rheumatism. There is no doubt that, as in rheumatoid arthritis, arduous occupations involving much use of the joints predispose to the disease. The photograph (Fig. 20, p. 243) is of a stonemason, in whom a large painless swelling of the right shoulder-joint was the first symptom ; he used this arm for his hammer. Again, one of my cases was a carpet planner, who knelt all day; he had an enormous painless swelling of both knee-joints. The poor women I meet with in the infirmaries suffering with Charcot's knee-joints nearly always gave a history of being widows who had to earn their living by charing and scrubbing, or by using the sewing-machine. Tabetic foot occurs more frequently in those whose occupation involves continuous standing (vide photographs of tabetic foot and shoulder). In the cases which came under my notice of joint affection there was usually a history of a trivial injury such as a knock, a false step going downstairs or from the kerb, or such like. The swelling was not invariably painless, and it appeared to me sometimes difficult to differentiate some of the cases from rheumatoid arthritis occurring in a person suffering with tabes or tabo-paralysis, had not rapid effusion into the joint indicated a true tabetic arthropathy.

Symptoms. A masterly description by Charcot of the tabetic arthropathies has led to the affection being named after him. He pointed out that without any sufficient cause a joint would suddenly swell up, owing to a serous exudation into it and possibly into its surrounding tissues. This swelling is unaccompanied by either pain or fever. In the favourable form the swelling may disappear after a time, and a return to the normal condition take place, or severe destruction of the joint may occur accompanied by crepitus, wearing away of the articular surfaces and even the bone, causing dislocations and luxations. The knee is by far the most frequently affected, after this the hip, shoulder, elbow, wrists, more rarely the ankle, vertebral, and finger joints. Marie states that from 4 to 5 per cent. of tabetics suffer from joint affections. When inco-ordination is associated with the arthropathy, the varying strain on the ligaments and tendons necessary to maintain the erect posture coupled with the hypotonus of the muscles may lead to retro-flexion of the knee-joints.

Pathological anatomy. The capsules and synovial membrane are thickened, contain excess of synovial fluid, and the cartilages are ulcerated (vide Fig. 43, and 'System of Syphilis', vol. ii, plate xvii).

In advanced cases the joint surfaces with the cartilages may quite disappear, and the bony structure in the joint may be destroyed and appear as eroded away. Proceeding *pari passu* with the atrophy there may be numbers of outgrowths in the capsule and synovial membrane. Chemical examination shows that the bones are deficient in mineral matter, especially phosphates. The Haversian canals are dilated irregularly and filled with fat. According as the process affects the epiphysis or the diaphysis an arthropathy or spontaneous fracture occurs, sometimes both. Similar joint affections may occur in syringomyelia.

A peculiar malformation arises when the joints of the tarsus are affected; on the back of the foot and in the middle of the sole there arises a hard prominence, the foot is flattened and shortened and the bones of the tarsus are, as it were, driven into one another. Crepitus is obtained on movement, but no pain produced. The ligaments of the joints may be destroyed. Tendinous tissue may probably undergo similar atrophic changes, for sudden painless rupture of a tendon which does not tend readily to heal may take place. The following case of tabes with manial depressive insanity suffered with a tabetic foot.

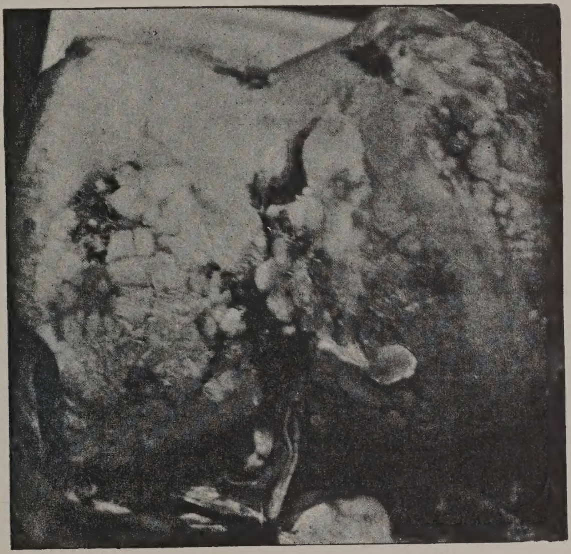

FIG. 43. The lower end of the femur, showing the ulceration of the cartilage in a case of Charcot's joint.

CASE 49. A. D., aged 49, widow, and by occupation a cook, was admitted to Hanwell Asylum, December 3, 1908.

Mental symptoms. Maniacal excitement and in addition auditory hallucinations, obeys her dead husband's commands. Very restless, demands champagne.

History. None of her friends have come to see her, but she herself says that she has been married ten years, has had no children, but several miscarriages, and that her husband died of a disease contracted by going with women.

Symptoms of locomotor ataxia.—Absent knee-jerks. Myotic pupils, typical Argyll-Robertson reaction. Lightning pains for the last two years, described as knives in her legs. Stamping gait, loss of co-ordination. Romberg's sign. The accompanying photographs of the left foot show the peculiar malformation above described when the joints of the tarsus are affected (Figs. 44 A and B); she can walk and stand without pain.

Whether the bone and joint disease of tabes is dependent upon a definite lesion of the nervous system is still a moot point.

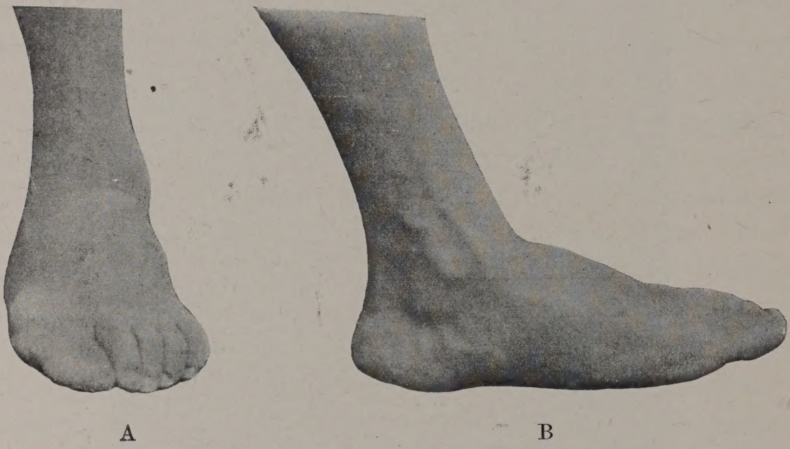

Fig. 44. Tabetic Foot. A. From the Front. B. From the inner side.

Charcot believed at first that it was due to a lesion of the anterior horns. Other authorities attribute it to a disease of the peripheral nerves, especially of those supplying the bones, but this condition does not occur in peripheral neuritis. The loss of bone sensibility may, however, be an early sign in tabes. I recently examined a patient who presented very little ataxy, and yet there was very distinct evidence of diminished bone sensibility by Egger's test, with the vibrating tuning-fork. Recently Marinesco has attributed it to anaesthesia and absence of reflex regulation of the blood-supply ; it may also be due to the direct action of toxins upon the nutrition of the bones.

In a large number of experiments which I made many years ago of section of anterior and posterior roots in monkeys, I never met with any changes in the bone with the exception of one case in which the posterior roots of the cauda equina were ligatured on the right side so as to cause degeneration; the animal was killed three weeks later. The bones of the leg on this side were so brittle that I could snap them with my fingers. The right femur was the same size as the left, when dried the right weighed 7·5 grams, the left 12·5 grams. The right os innominatum was the same size as the left, when dried the right weighed 5·5 grams, the left 7·7 grams. The tibiae were also brittle, but were used for microscopical purposes. After softening in chromic and picric acids transverse sections were cut by the freezing microtome, stained with logwood and eosin, and mounted in Farrant's solution.

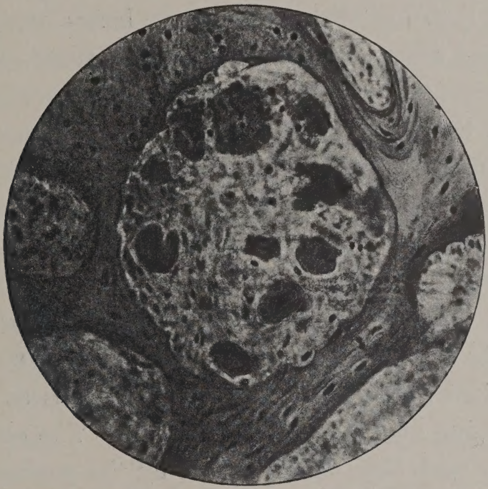

FIG. 45. Photomicrograph of a section of a tibia of a monkey (experimental lesion of posterior roots) softened in a mixture of picric, nitric, and chromic acids, stained with alum haematoxylin, and mounted in Farrant's solution. Magnification 300 diameters.

There was a naked-eye osteo-porosis on the right side. The periosteum was apparently normal. Examined microscopically there was a marked dilatation of the Haversian canals, and owing to the absorption of the intervening bone, coalescence had taken place with the formation of irregular shaped channels, which contained blood-vessels surrounded by a reticulum of connective tissue in which were seen numerous osteoclasts ; these large cells were disposed usually at the periphery lying in little scalloped out places which they filled and which they had apparently caused, by absorption of the osseous substance (vide photomicrograph, Fig. 45).

Bayliss and Starling have shown that stimulation of the lumbo-sacral posterior roots causes dilatation of the vessels of the lower limb ; therefore vaso-dilator excitation may have been set up by the ligature and caused dilatation of the vessels of the lower limb including those of the bones, with consequent absorption and diminution of the mineral matter ; for although, as we have seen, the bones were equal in size, there was a marked difference in the weight, and microscopically it was found that this was due to absorption of the osseous matter around the Haversian canals.

Inco-ordination. The characteristic ataxia develops gradually ; it is usually increased in the dark or on closing the eyes, and may at first only be present when the visual guiding sense is absent. Before ataxic gait appears there may be a static ataxia and the patient notices that he sways and feels as if he would fall when closing his eyes to wash the face. The early defect in co-ordination may thus be discovered by the patient or he may discover it by finding a difficulty in walking in the dark or ascending or descending stairs, or walking backwards. The inco-ordination of gait and station may be early symptoms, but as a rule they do not occur until the disease is well advanced and after the patient has suffered for years from lightning pains, bladder troubles, gastric crises, or other symptoms. Romberg's symptom is the swaying and tendency to fall which is observed when a patient is made to stand with the heels together and the eyes shut ; the narrower the basis of support the more difficult does the patient find it to maintain his equilibrium ; he therefore cannot stand on one foot. The effect of removal of the visual guiding sensation is more marked when the patient has lost sensibility in the soles of the feet, but it does not wholly depend upon this loss of sensibility, for swaying may be marked when the sensation of the soles of the feet is perfect. The difficulty is often noticed to be greater when the feet are bare; this is because muscular action has to supplement the support which the boot usually affords. The patient may sway from side to side or from toes to heels. The uncertainty of gait and station progresses and it becomes noticeable even with full visual guidance, especially on uneven ground, going up and down stairs, or on a smooth surface. A slight visible alteration in walking is observable, there is a change in the mode in which the feet are placed on the ground, there is a noticeable difficulty in turning round suddenly and he stamps the foot down to prevent falling. As the muscular inco-ordination and hypotonus increases the change in gait becomes greater, but naturally this change varies in precise characters according to the roots affected. The patient after a time walks with a noticeably wide base and finds it necessary to use a stick to increase the base of support, the feet are raised too high, thrown forwards too far, and brought down suddenly with a stamping action; it may be necessary even to have a supporting arm, although only a slight degree of help is at first necessary, for it is guidance and the feeling that he will not be allowed to fall which is so needful. Later the inco-ordination may be so great as to necessitate a stick in one hand and the support of an arm on the other, the legs being thrown out in such a jerky inco-ordinate manner, even when guided by vision, that he would be unable to stand or walk without such support. Eventually he may be unable to stand even with help, for when attempts are made to rise, the wasted limbs are jerked about in such an irregular inco-ordinate manner that he is unable to assume the upright position, and if he succeeds in so doing, owing to the atrophy, hypotonus, and inco-ordination they refuse to support the body and slip away forwards in front of him, only the strong support of the attendant preventing him falling. The inco-ordination is also observable when the patient is lying in bed, for if he is asked to try and touch an object with his foot the leg is thrown wide of the mark and the inco-ordination is more marked when the eyes are closed.

As a rule the arms are affected much later than the legs and not infrequently there is no inco-ordination of movement observable in them. Occasionally, but rarely, the arms are affected first and most markedly (brachial tabes). This defect is usually first revealed in the finer movements of the hand such as in writing. It may be tested by telling the patient to touch some object with his eyes closed, such as the tip of his nose, or he may be asked to hold his hands out and bring the tips of the fingers of the two in apposition. As it increases, all movements are performed with difficulty; thus the patient may find it difficult to unbutton and button up his trousers before and after micturition, and this may lead to his bladder becoming distended, and grave complications may arise therefrom.

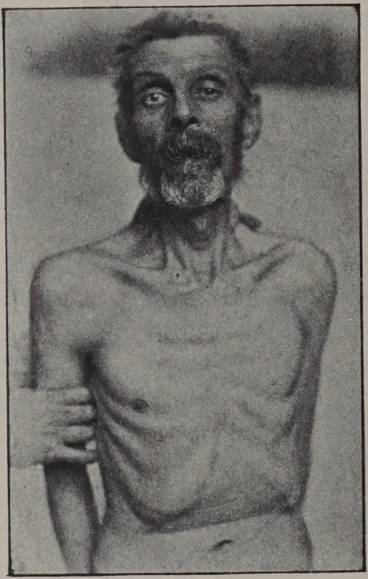

FIG. 46. Showing the lower ribs drawn in by contraction of the diaphragm, causing a groove in the abdomen.

The grasp is not sustained; first one finger relaxes and then another. Occasionally the trunk muscles present signs of inco-ordination; thus a patient may be able to sit steadily on a chair with his eyes open, but if he closed them would at once fall off. It is remarkable that 'the movements of the head, face, and eyes escape the characteristic derangement' (Gowers).

Muscular wasting with degenerative changes is extremely rare. I have reported a case in which such wasting occurred, and subsequently I found atrophic changes in the anterior horn cells of the corresponding segments of the lower cervical spinal cord which were quite sufficient to account for the changes observed during life.

In the paralytic bed-ridden stage there is great muscular wasting and there may be a great amount of loss of tissue of the abdominal muscles, so that when the diaphragm descends in inspiration the flaccid abdomen is ballooned out. Again, the belly may be retracted and owing to atrophy of the quadratus lumborum and oblique muscles the lower ribs are drawn in on contraction of the diaphragm and a groove is formed as shown in the accompanying photograph (Fig. 46).

Cranial Nerve Affections

Affections of the cranial nerves are less frequently met with; it is not common to find the olfactory nerve affected in tabes, but occasionally, as my cases have shown, loss or imperfection of smell and the taste for flavours has occurred. Sometimes this was preceded by a curious and continuous odour in the nostril, like a drain; it is sometimes likened to rotten fish, phosphorus or sulphur, and paroxysmal attacks of this perverted olfactory sense may precede the complete loss of smell. These attacks, when they occur, are of the nature of crises and may last hours, days or weeks; it is of importance to bear this in mind in connexion with the subjective attitude of an insane tabetic patient, or a tabo-paralytic, to these abnormal sensations; unable to explain their presence, he might put an insane interpretation on them, thinking that his food was poisoned, or that foul odours by unseen agencies were working upon him. Although loss of smell and the taste for flavours is rarely met with in tabes, it is occasionally met with in tabo-paralysis and general paralysis, and this accords with the anatomical results found post mortem, for the orbital surface of the brain and the tip of the temporal lobe in which it is presumed the sense of smell and taste is located, are very generally the seat of extensive atrophy and thickening of the membranes.

Sometimes the patients are said to lose sensibility of the mucous membrane of the nose, and no longer sneeze when it is irritated, or they may be subjects of paroxysmal attacks of sneezing and tickling of the nasal mucous membrane. This is due to affection of the nasal branch of the fifth nerve, and is rare. Other affections of branches of the fifth nerve are pains, anaesthesia and paraesthesia in various regions of its distribution. Besides these disturbances of sensibility, there may be various so-called trophic disturbances, such as a rapid falling out of the teeth, and absorption of the alveolus of the jaw. Several of my cases showed this, but in some instances it may have been due to the mercury given in the treatment of syphilis. The sensory disturbances of the fifth are sometimes manifest, and sometimes so trifling as to be unobservable; there does not appear to be any relationship between the teeth dropping out and absorption of the jaw and anaesthesia of structures supplied by the fifth. This is in accordance with what we know of joint and bone diseases, which are frequently very early symptoms, and are in no way related to the sensory disturbances of the skin; the teeth fall out without any pain being experienced.

Other rare conditions due to affection of the trigeminus have been described, namely, ophthalmia neuro-paralytica and corneal ulcer. Both corneal ulcer and tabetic ulcer of the mouth are analogous to the perforating ulcer of the foot. Again, sialorrhoea, which occasionally occurs, generally in paroxysmal attacks, has been attributed to affection of the trigeminus. Quite exceptionally the motor root of the fifth is affected.

Disturbances of taste, due to affection of the glosso-pharyngeal nerve, are very rare; cases do occur occasionally in the form known as medullary tabes.

Auditory nerve. This nerve is only rarely affected, the lesion may be irritative or paralytic. Paroxysmal attacks of noises in the ear like rushing water, bells, or shrill whistling sounds, or even musical sounds may be heard. This no doubt is due to affection of the cochlear branch of the auditory nerve, but the neurones supplying the semi-circular canals may be also affected and give rise to symptoms resembling Menière's disease, viz. giddiness and attacks of loss of balance. But it is always difficult to decide whether these attacks are not really due to associated migraine, or slight attacks of *petit-mal.* Again, it may be the result of congestive seizures of tabo-paralysis. According to Sir William Gowers, only when there is a progressive limitation of the range of hearing, analogous to peripheral limitation of the field of vision, are we justified in assuming nerve atrophy.

Symptoms pointing to affection of the vago-accessorius may occur, viz. an habitual acceleration of the pulse rate; heart crises have been described in which there is a violent precordial pain radiating to the shoulders, especially the left, with a feeling of oppression and during the attack tachycardia and arythmia —a condition similar to angina pectoris. Seeing that aortic disease and aneurysm are not infrequently met with in tabes, the attacks may partially be owing to the same cause as true angina pectoris and there is always the possibility of sclerosed coronary arteries.

The hypoglossal is also not immune, for cases have been recorded of unilateral atrophy; atrophic affection of the tongue belongs to the early symptoms. Very rarely is it bilateral. The cranial nerve symptoms often occur in groups.

Vaso-motor and Trophic Disturbances.

Several conditions already mentioned may be regarded as trophic disturbances due to the changes in the sensory protoneurones, but one of the most striking illustrations of trophic change is afforded by perforating ulcer. This condition has been found to be almost confined to tabes; it may commence in a corn; the most frequent situation is the sole of the foot or one of the toes, more often the great toe, it may be on the back of the toe. It is a suppurative process owing to deep-seated mischief which bores through the skin; frequently there is carious bone at the bottom of the fistula, from which a little foul-smelling pus escapes continually. These ulcers are painless and very difficult to heal.

Local sweating has been observed confined to the soles and palms or to one side of the head.

Herpes occasionally occurs, usually in association with an attack of pain. The growth of the nails may be affected; those of the feet and sometimes those of the hands may become thickened and furrowed or show irregularity of their surface; or the nails may fall off and only slowly be renewed. Ecchymosis of the skin and changes in the growth of the hair in connexion with attacks of pain have been reported. The pigment may disappear from the skin and hair in patches.

Cerebral Symptoms in Tabes and Tabo-paralysis

I have already alluded to the frequency of optic atrophy in the cases of tabes and tabo-paralysis which have come under my observation. I will now refer to other cerebral symptoms. Mental symptoms occurred in about 10 per cent. of the cases seen outside of the asylums; some few of these were pronounced general paralytics of the tabetic type, others were tabetics with symptoms indicating early organic affection of the brain, and the remainder were cases of tabes dorsalis with associated insanity. Some of the cases seen in the hospitals and infirmaries afterwards died in one of the asylums at a near or remote period from the time I saw them. One case in particular, J. W., attended my out-patients' department for several years, affected with progressive optic atrophy, limitation of the field of vision, and early signs and symptoms of cord affection. I lost sight of him for some years, but found him suffering with advanced general paralysis in Claybury Asylum, and he died there. The same types of tabo-paralysis were met with in the asylums, the only difference as a whole between the cases was what we would expect: in the former the cord symptoms predominated, in the latter the mental symptoms. It was, however, a well-established fact that some patients who had been observed outside asylums as cases of locomotor ataxy, after admission to the asylums, and therefore after the development of well-pronounced mental symptoms, without treatment of any kind, became less ataxic in their movements, the gait becoming altered. I have met with a number of cases in the asylums who were admitted for an attack of mania, and after the attack has passed off have remained in the asylum owing to their ataxia, which has progressed, while the mental symptoms have cleared up in great measure; at any rate they have been non-progressive. When intercurrent disease or complications have carried off such patients, I have found post mortem some thickening of the meninges and slight atrophy of the subjacent convolutions. Some of these may be regarded as cases of tabo-paralysis, others as mania supervening in a tabetic patient. Again, a few cases are admitted to the asylum suffering with suicidal impulses the result of the mental depression produced by the pains and the knowledge that they were suffering with an incurable disease. As in general paralysis so in tabo-paralysis, the onset of cerebral symptoms may be sudden, and due to seizures which are recognized as congestive, apoplectiform, epileptiform, and migrainous. The seizures may lead to a disturbance of consciousness, or partial or complete loss of consciousness. Thus a patient may be suffering from discovered or undiscovered objective or subjective signs and symptoms of tabes dorsalis, when suddenly, or comparatively suddenly, he is seized with some kind of fit. There may be a temporary disturbance of consciousness, a sudden feeling of giddiness, associated with frontal headache like migraine. Generally such an attack is due to circulatory disturbances of the brain; but it is conceivable that in rare cases of tabes, frequent migrainous attacks may be due to disturbances of the sensory impressions from the semi-circular canals. These attacks often escape observation, until one more severe necessitates a doctor's advice, when the true nature of the disease may be discovered by the examination of the pupils and the condition of the knee-jerks and other signs of tabes or tabo-paralysis. This will lead to further inquiries of the patient for such early subjective symptoms as lightning pains. Often, however, the patients disregard these slight attacks, and such cases do not come under observation until more serious brain symptoms develop. Some of my cases show that a history obtained from the wife or friends may give evidence of such attacks occurring years before the patient suffers with mental symptoms severe enough to cause his admission to the asylum. Epileptiform seizures may be the first evidence of cerebral affection, and may precede or succeed spinal symptoms.

I have frequently found, by questioning the wife, that her husband, previous to his coming to the asylum or the hospital, had a fit with convulsive spasms affecting one side. He had recovered from this, and was comparatively none the worse for it. In 30 per cent. of sixty cases of tabo-paralysis the patient suffered with numerous epileptiform seizures. In 34 per cent. there was a history of one or more fits, but seizures did not form a prominent symptom of the disease. In the remaining 36 per cent. no fits were observed by the friends or attendants during the whole course of the disease. Epileptiform seizures in the case of well-marked tabes, where there is presumably well-marked degeneration of the posterior roots, were not notably characterized by inco-ordination in the convulsive spasms. Congestive seizures and apoplectiform seizures, likewise the mental symptoms, have been already discussed in Chapter VIII. Persons potentially insane or with the inborn psychopathic temperament may, quite apart from organic changes in the brain, develop systematized delusions of persecution on account of the pains and visceral disturbances. They put an insane interpretation upon the pains and visceral crises. These delusions are often accompanied by hallucinations, auditory and visual. I have observed that patients with optic atrophy are particularly liable to develop visual hallucinations, and I have thought that probably this may be an expression of the irritation of the optic path in persons potentially insane. This, however, cannot be the case with auditory hallucinations which are frequently met with in asylum cases of tabes. In 28 per cent. of sixty asylum cases of tabes the patients were affected with delusions of persecution, poisoning, electricity, &c. In three-fourths of them there were either auditory or visual hallucinations, often the two combined; and the majority of them had an hereditary history of insanity. The delusions of persecution associated with electricity in the body, the poisoning of food, twisting of the bowels, withdrawal of the semen (impotence), bad smells and tastes, may have an organic basis in a patient suffering with tabes, but when the patient associates those pains with the voice he hears of some particular individual who follows him day and night to persecute him, and if there is no dementia, it is probable we are dealing with a paranoiac the subject of tabes. According to my experience delusions of persecution, especially if systematized, point more to tabes associated with inherent insanity than tabo-paralysis; for grandiose delusions, exaltation, and *bien être* very frequently supervene in a tabetic who develops paralytic symptoms (vide p. 267).

When the mind is affected and the disease has progressed to a deep dementia they cease to complain of the pains due to the spinal root lesions.

A tabetic patient with mental symptoms who has the knee-jerk absent on one side and present on the other, or who gives a history of migrainous, epileptiform, apoplectic, or congestive attacks is in all probability a tabo-paralytic. I have seen tabetic cases sent from the infirmary to the asylum as insane, whose hallucinations were entirely due to the morphia they had been taking to relieve the visceral crises and the attacks of pain.

Cardiac Symptoms

I have already pointed out that *pseudo-anginal* symptoms may occur in tabes, and I have recorded a case (p. 357) of laryngeal crises which was for some time thought to be laryngeal paralysis due to the pressure of a small deep-seated aneurysm. Strümpell has recently called attention to the connexion of tabes dorsalis with disease of the heart and the vessels. Berger and Rosenbach were the first to draw attention to the relative frequency of the coincidence of tabes and aortic insufficiency. Many attempts were made by different authorities to explain this coincidence: some said it was merely coincidence and there was no causal relationship; others said that the pains of tabes affected the heart; while others again thought it was the heart affection which caused the tabes. But with the increase of our knowledge we recognize the fact that it is the syphilitic poison which is the cause of both; two different results of the same cause as Strümpell puts it. According to Strümpell, Ruge and Hüttner found in 138 cases of tabes, heart failure twelve times, and marked aortic insufficiency nine times. Enslin has described 17 cases of tabes with aortic insufficiency and Schuster 3 cases out of 22 cases of tabes. The disease is not limited to the aortic valves, but there is a marked preponderance over affection of the mitral valves. Lesser found an aneurysm in 18 cases out of 96 cases of tabes. Strümpell associates the common occurrence of high tension pulse with the accompanying arterio-sclerosis, also the recorded cases of angina pectoris and cardiac asthma of tabes.

He also comments upon Von Leyden's explanation relating to the case of a married woman who, at the age of 40, developed aneurysm of the aorta. Von Leyden associated the aneurysm with strain caused by attending on her tabetic husband. Strümpel remarks that the probable explanation was the husband had infected the wife with syphilis.

CLASSIFICATION OF CASES OF TABES

The cases of tabes and tabo-paralysis may be classified clinically, according to their motor disturbances, as follows :

(1) Motor disturbance slight or not discoverable. Preataxic condition, disease spinal :—Loss of deep reflexes on one side or both sides, slight hypotonus. No subjective motor trouble. Objective signs only discovered by expert examination. Other signs and symptoms lead to diagnosis.

(2) Preataxic condition simulated, spinal combined with cerebral or optic disease :—In such cases the spinal disease may at one time have produced subjective symptoms and objective signs of ataxy, and the onset of the mental symptoms or the optic atrophy with blindness masks the same, or causes them to disappear partially or entirely. There may be loss of knee-jerks, or the knee-jerk may be lost on one side only, or it may return on one side after a series of unilateral fits. Most common in asylums.

(3) Ataxy of first stage, subjective difficulty only in the dark, or with eyes shut, discoverable by examination, same as (2) without mental affection :—Loss of deep reflexes, well-marked loss of tonus, Romberg's symptom moderate. The examination of the nervous system in such cases shows considerable atrophy of posterior roots, half to one-third of fibres and their intraspinal projections destroyed.

(4) Ataxy of second stage, obvious ataxic gait, difficulty of gait and station in daylight, necessitating support :—Nearly complete atrophy of the lumbo-sacral root-fibres, considerable atrophy of endogenous systems of fibres.

(5) Paralytic bed-ridden stage, frequently accompanied by deformity and great muscular wasting, especially of certain

groups of muscles, which may in rare instances undergo degenerative atrophy.

Course and Termination

The disease usually runs a chronic course ; it extends on an average over a period of ten years, but it may be as long as twenty or thirty and even more years. A patient rarely dies within a few years of the onset of symptoms. I have known cases remain for twenty years or more in the preataxic stage ; on the other hand the patient may in a short time after the onset of definite symptoms become helpless and bed-ridden from rapid progress of the ataxia.

The onset of the symptoms or the rapid progress of the disease may follow exposure to cold and wet, falls and injuries ; still more common is a rapid increase of the symptoms in consequence of sexual excesses, debauchery, and alcoholism. I have met with cases in which symptoms of tabes have come on after an attack of malaria, influenza, and other diseases ; but there has always been a syphilitic history. One of the commonest causes of aggravation of the symptoms, and one fraught with danger, is due to residual urine in the bladder undergoing decomposition, causing cystitis, which subsequently leads to an infective pyelo-nephritis. Too much care cannot be taken to avoid this dangerous complication and it is well to remember that this is a common cause of a remittent pyrexia. The course of the symptoms is most variable ; in some the pains are so severe as to be the principal subjective sign of the disease ; one case under my care was thought to have suffered with bilateral sciatica for four or five years, because he had no ataxy ; in others the ataxy is marked and the lightning pains are of less moment. Periods in which the disease is apparently stationary for months or years may alternate with exacerbations for which one of the causes mentioned above may be elicited, or they may be apparently spontaneous and own no discoverable exciting cause. In most cases there is nothing in the nature of the disease itself to cause death. The cause of alarming symptoms is laryngeal paralysis or spasms, and occasionally owing to this cause the disease *per se* may occasionally prove fatal. Although gastric crises are most alarming and lead to great prostration they are never fatal. One cause of death is suicide or misadventure from taking drugs to relieve the pains. I have seen patients in the London infirmaries who have been there for twenty years bed-ridden. Death often results from intercurrent diseases, from fractures ending in suppuration, and from bed-sores. By far the most common cause as before said is pyelo-nephritis, the result of cystitis. Broncho-pneumonia also is a frequent cause of death. In rare cases there may be a muscular wasting with reaction of degeneration. About 10 per cent. at least of the cases of tabes develop dementia paralytica and then die, as a rule, within four years. I have found that a large proportion of these tabo-paralytics suffer with optic atrophy; therefore it is not safe to assert a long duration of life when optic atrophy leads to blindness. Worry and mental stress doubtless lead to the brain degeneration.

Syphilitic tertiary lesions of the skin and viscera are not common, nor is syphilitic endarteritis affecting the cerebral vessels, but arterio-sclerosis, aneurysm, and valvular disease, especially aortic disease, are relatively frequent in tabes. Their conditions are more than coincidence for they own a causal relationship to syphilis, and it is well to remember that a true *angina pectoris* from sclerosed coronary arteries may arise in a tabetic patient and the characteristic pains might be wrongly attributed to the tabes. A certain number of patients die of pulmonary tuberculosis, but this is not nearly so frequent a complication as in general paralysis.

Prognosis. The prognosis in tabes largely depends upon the stage in which it is first discovered and the life and habits of the patient subsequently. Arrest of the symptoms is not infrequent and considerable improvement is not rare. When the disease has advanced to the second ataxic stage, there is less hope of arrest, but even then in some cases considerable improvement may be obtained. It is well nigh impossible to predict what will be the course in an individual case. Some cases of pseudo-tabes, really diffuse syphilitic spinal meningitis with symptoms resembling the true tabes, undoubtedly clear up in a remarkable manner under anti-syphilitic treatment, but then these are not cases of tabes dorsalis; probably these are the cases of acute onset that have been recorded as recovering. Each attack of pain indicates irritation prior to degeneration of root-fibres, and I have myself observed the knee-jerks disappear after an attack of lightning pains lasting some days; also I have seen a patch of anaesthesia of the thorax occur after severe pains in that region accompanied by gastric crises. The occurrence of optic nerve atrophy is often followed by arrest of the symptoms in other parts, and as Benedikt first pointed out patients frequently remain a great number of years in the preataxic stage. One of my patients was a teacher of the blind, and it was not till twenty-four years after he lost his sight, and when he was over 50, that he developed ataxy. Another patient developed ataxic symptoms at 65, and when he was 72 he was still in the preataxic stage. The statistics of Marie and Moquet show that although tabes weakens the individual it does not on the whole materially shorten life. Thus of sixty-six tabetic patients who died at Bicêtre 51·5 per cent. were over 60 years of age and 83·3 per cent. were over 50 years of age. Of fifty-eight still living 43 per cent. were over 55 and 68·9 per cent. were over 50 years of age.

The diagnosis is treated under spinal affections (p. 175).

Treatment. When a patient comes suffering with signs or symptoms of the disease, it is essential to inquire into his habits and mode of life, so that such advice may be given as will lead to a security as far as possible from all influences which would cause excitement or depression of the nervous system. It must be remembered that the syphilitic poison has lowered the durability of his nervous system and neuronic decay will result from all those causes which produce stress, such as excessive mental work, worry, anxiety, emotional disturbances, and particularly sexual excesses and alcoholism; in a word all the conditions that produce neurasthenia. Consequently he must be warned, but without unduly alarming him, that it is essential for him to live a very steady, quiet, simple life. Care should be taken to avoid the risk of falls, exposure to cold and wet, and if practicable he should reside in the winter in a warm, equable, dry climate.

If the patient can afford the expense he might pass the winter and spring in Egypt, Tunis, Algiers. In sending a patient in the early stage of tabes abroad the danger of malarial infection should be considered, for I have heard of cases of officers and men in the army and navy the subjects of antecedent syphilis in whom symptoms of tabes came on after malarial infection. The following is an interesting case. A naval officer, aet. 37, consulted me for tabes. At the age of 23 he had a chancre and was treated for six months with mercury. At Aden he had malaria with fever and immediately after the lightning pains were noticed. He returned to England and after a night of debauchery he became quite impotent; the first symptoms came on nine years after the chancre.

When the patient is in the preataxic stage a sea voyage in some cases may be beneficial, but it must be remembered that cerebral symptoms or suicidal impulses frequently occur, and if he is ataxic it is out of the question owing to the liability of his falling and suffering thereby injury and aggravation of the symptoms. I was consulted not long since with regard to a tabetic marrying, and I expressed the opinion that even if the bride were willing to become a nurse and knew fully the circumstances, it was still undesirable. Sexual excesses often lead to impotence and this preserves many patients from the dangers which might arise therefrom afterwards; but a man who has become impotent feels the joy of life has gone and he worries himself into a state of nervous exhaustion. Sir William Gowers asserts that sexual excess seems to have a special influence in the production of optic nerve atrophy. Several painful instances of this have come under his notice. Thus 'A man in the early stage of tabes, with slight atrophy, some peripheral limitation of the fields, but little impairment of acuity of vision, started on a voyage from Australia to England. The day before he started he married, and when he reached this country he was quite blind'. I have heard of similar cases which have developed general paralysis. Care should be taken to attend to the bowels and a light digestible diet should be ordered; for if a patient is leading a quiet and relatively inactive life his digestive organs will not tolerate heavy meals with excess of meat; moveover, I have found that constipation and dyspepsia aggravate the pains and tend to gastric crises. Aperients and digestive tonics therefore may be beneficial as stimulants, but in excess are very harmful, and only a small quantity of alcohol (preferably in the form of light wines) should be permitted.

The lightning pains and visceral crises may be relieved by 5–10-grain doses of veronal and bromural. Antipyrin in 10-grain doses also frequently relieves, but sometimes the symptoms are so severe that no relief to the suffering can be obtained except by the use of morphia, and hypodermic injections of $\frac{1}{4}$ to $\frac{1}{2}$ gr. with $\frac{1}{150}$ gr. of atropine will have to be administered. The hypodermic needle and the morphia should not be put into the hands of the patient or the morphia habit may be established. Sometimes relief may be obtained by morphia suppositories, or nepenthe may be given in a prescription to be taken occasionally when the pains are very severe; the nature of the drug not being revealed. Should bladder troubles arise and residual urine with cystitis occur, the treatment adopted on p. 476 should be employed. The bowels may be regulated with laxatives and dieting and nervine tonics, e.g. strychnia, may be prescribed with advantage. It is well, however, to inform the patient that more benefit is likely to occur from his leading a regular, simple, hygienic mode of life than by attempting to cure the disease by vaunted nostrums.

A certain amount of muscular exercise is beneficial, but care should be taken to warn the patient against over-fatigue and any muscular exertion which would produce exhaustion. I have pointed out that in the synergic movement of progression in walking the primary movement is flexion of the hip, but the associated movements of flexion of the knee and dorsal flexion of the foot occur; and there is a failure in this dorsal flexion. I advise my patients when they are in bed to wear knitted stockings and a cradle or some arrangement to take off the weight of the bedclothes; for this continuously acting upon the dorsal flexors in their hypotonic condition adds to the loss of tonus. I also advise them as part of the exercises which constitute Fränckel's treatment, particularly under the guidance of vision and while lying on their back, to practise simultaneously flexing the hip and knee accompanied by dorsal flexion of the foot. A systematic course of massage and passive movements together with exercises in the following manner may be practised. The patient should be made to practise daily walking along a line by the aid of vision in such a way as to get the synergic action of the hip, knee, and ankle. If unable to walk without assistance, he may lie in bed on his back and practise directing the toe of the foot on a board upon which various figures are chalked.

It is very important to warn the patient against distension of the bladder; he should never allow it to become over full as this will tend to atony and residual urine. Mental anxiety, worry, and anything which causes mental depression have a prejudicial effect upon the nervous system in this as in all other chronic nervous diseases; in many cases, however, it is impossible to prevent the causes of mental stress, for a man may have a wife and family to support and he knows that he is suffering from a slow, insidious, painful, incapacitating and progressive disease. Should smoking be prohibited? Smoking is a solace to the mind of many men and it is a great hardship to give up their pipe; by some physicians it is considered desirable to prohibit tobacco from the fear of its affecting injuriously the sight, but I am inclined to agree with Byrom Bramwell's aphorism 'Smoking in moderation does not injuriously affect the busy man who thinks; it only hurts the lazy man who drinks'.

Although syphilis is for reasons already stated the essential cause of tabes dorsalis, it is the general experience of physicians that it is seldom that any benefit is obtained by antisyphilitic remedies. Byrom Bramwell says: 'Personally I have rarely if ever seen any decided benefit result from iodide of potassium and mercury, even in cases in which the disease has developed soon after the primary sore. I remember one case in particular in which the symptoms of locomotor ataxia developed three years after the initial lesion and in which no benefit whatever resulted from antisyphilitic treatment.' Occasionally I have in early cases tried the effect of mercury and iodide, but I have never seen myself any benefit arise therefrom and I have sometimes thought it has done harm, and Bramwell affirms that a vigorous antisyphilitic treatment, when it fails to do good, is apt to do harm. With the knowledge which the biochemical examination of the blood and cerebro-spinal fluid affords, as well as the cytological examination of the latter fluid, we have really a means of ascertaining whether mercury and iodide should be administered, and if administered, whether the treatment should be continued. If neither the blood nor the cerebro-spinal fluid give an antigen reaction, but only the antibody, it is of little use administering mercury. The lymphocyte count and the amount of albumin present in the cerebro-spinal fluid is an index of the degree of the activity of the morbid process, and should both be diminished to an appreciable extent by therapy it may be conceded that the treatment is doing good and may be continued. Thus the case of laryngeal crises in a tabetic patient (described on p. 357), who is still in the preataxic stage, is being treated with mercury and iodide after having had the blood and cerebro-spinal fluid examined; if at the end of a fortnight the examination shows an appreciable diminution of lymphocytes and albumin I shall continue the treatment.

GENERAL PATHOLOGY OF TABES AND TABO-PARALYSIS

We have already seen that some clinical cases may show all grades of tabes, from slight mental symptoms and pronounced cord symptoms to those of very pronounced mental symptoms and slight cord symptoms. Consequently there must be a number of intermediate cases between the two extremes, and it would be extremely difficult to decide whether they should be called tabes or general paralysis, and the invention of the term tabo-paralysis is an indication of this clinical difficulty. In like manner, and as a matter of expediency (especially among private patients) such cases are at first called locomotor ataxy. There can be no hard and fast clinical line between the two diseases; etiologically I have shown that they are practically identical; are they pathologically so? This question can be studied best by an examination of a sufficient number of these intermediate cases. Nageotte asserts that he found changes in the posterior columns in two-thirds of all forms of cases of general paralysis, and he looks upon the diseases as pathologically identical. Fürstner, who has made a most careful study of this subject, does not agree with Nageotte that the spinal cord exhibits typical tabetic lesions in anything like so large a proportion. He concludes that the spinal cord is invariably affected in some part of its structure in general paralysis; he states that cases certainly occur where the spinal lesion occurs first; also a series of clinical symptoms corresponding with the anatomical findings.

Watson found posterior column degeneration of exogenous systems in five out of eight cases of juvenile general paralysis.

I have advanced very strong proofs that syphilis is the essential cause of both these diseases, a doctrine which is daily becoming more widely accepted. Then just as we find that alcohol, lead, diseased maize, ergot, and other poisons may produce in one individual a morbid process in the brain, in another in the cord, or peripheral nerves, although the disease attacking the nervous system is essentially the same, so the effect of the syphilitic poison on the nervous system may in one person produce a degeneration of the spinal afferent protoneurones, in another of the optic nerves, or the cerebral cortex. Thus, according to the structure affected primarily, the disease may be classified as spinal tabes, optic tabes, tabo-paralysis, or general paralysis. The pathological identity of the two diseases is, moreover, supported by the following facts, that in active conditions of tabes and paralysis the lymphocyte reaction is found in the cerebro-spinal fluid, also the presence of albumin; moreover, the cerebro-spinal fluid in both diseases gives the Wassermann reaction in proportion to the amount of nervous structure that has undergone decay (vide pp. 210–14).

Here I will also take the opportunity of remarking that some of the most rapidly progressive cases of paralytic dementia I have met with have been those in which, simultaneously with the brain affection, there has been cord affection also. A case of juvenile paralysis, published in the first volume of the *Archives of Neurology*, p. 278, died within four months of the onset of the disease; several other cases likewise showed a rapid progress. The onset of the cerebral symptoms generally, but not necessarily, leads to a cessation of the morbid process affecting the spinal cord and vice versa; it may then be asked, is the disease one affecting the vital energy of the neurones of the whole nervous system; and in the struggle for existence, do those die upon which the greatest amount of stress falls, aided by contributory precarious vascular supply, or some devitalizing condition, especially hereditary defective durability? But how can the environment affect the decay of structure, unless there is a deficiency in the nutritive properties of the environment of the neurones?

I have pointed out in Chapter V, p. 186, that modern research tends to show a profound biochemical change in the blood as a result of the action of the syphilitic virus, and it is possible that there is a biochemical defect or subminimal deficiency in the blood of lecithins or lipoids. Those nerve structures with the highest vitality, in a struggle for existence, would be able to extract a sufficiency of the necessary complex phosphorized materials for maintaining physiological equilibrium; whereas, if there is a total insufficiency, those with less *vis propria* would first waste and undergo atrophy. A vicious circle is very apt to be established when structures presiding over important functions of the body are diseased, and then secondary complications arise and may be mistaken for the initial cause. I look upon these diseases as primarily a premature process of decay; the term 'abiotrophy' introduced by Sir William Gowers (*Lancet*, May, 1902) expresses aptly in one word what has been said above, and previously expressed in my Croonian Lectures.

The disease, whether it is elective (affecting only some particular system of afferent fibres in the spinal cord or the optic nerves), or whether it affects only the cerebral cortex, is a veritable tabes or wasting. This wasting, however, may be general and affect the whole central and peripheral nervous systems. In many cases of tabo-paralysis the cord is so wasted that in a big man the cord is not so large as that of a two-year-old child. Both grey and white matter are atrophied, and without any proportional overgrowth of glia or thickening of membranes.

The process as thus seen appears to be a rapid biochemical failure on the part of the neurones to maintain physiological metabolic equilibrium.

The paroxysmal attacks of pains and crises, maniacal and epileptiform seizures, are clinical expressions of an irritant action, and suggest the formation or accumulation in the blood or lymph of some toxin which has a local action, unless we assume that the decay of the neurones (terminating in death) is accompanied by increased irritability. In the discussion of the changes in the brain, we shall see that there is much more reason to suspect the existence of an irritant toxin which produces acute destruction of the neurones and formative proliferation in the vessel walls and perivascular lymphathic sheaths, also active glia proliferation —all being the results of a conspiracy of morphological and biochemical factors. In the case of the spinal cord, the thickening of membranes and the changes in vessel walls are inconstant, and can in no way account for the elective destruction of fibres in the posterior columns; although, as I have previously said, initial affection of certain segments of the spinal cord, as shown by the symptoms—especially the cutaneous sensory disturbances—may be explained by a precarious vascular supply in these regions; but then this is not the essential factor, only the contributory one. Morbid anatomy and clinical observation show that there is both systemic and segmental election in the pathological process.

Morbid Anatomy of the Spinal Cord and Peripheral Nerves in Tabes Dorsalis and Tabo-paralysis

Macroscopic appearances. Upon opening the spinal canal in an advanced case of tabes, the most obvious changes noticeable are the flattening of the cord, and the grey wasted appearance of the posterior roots of the cauda equina and of the dorsal and lower cervical regions; the soft membranes also are thickened in the dorsal aspect. When the cord is removed with the posterior spinal ganglia there is a marked contrast observable in the appearance of the anterior and posterior roots and the anterior and posterior aspects of the spinal cord; whereas the anterior roots are white and are of normal thickness, the posterior (normally twice the size of the anterior) are grey and greatly diminished in thickness. The anterior aspect of the cord is normal or nearly normal in appearance, the posterior is shrunken, and often, owing to the shrinkage, concave in the middle; the membranes are thickened and the posterior columns have a grey appearance. The cord when cut transversely exhibits a grey degeneration of the posterior columns and a shrinking and hardening of them, so that the two posterior horns of grey matter which also are atrophied, are closer together than normal. Although the posterior roots are much atrophied, the spinal ganglia do not present any obvious naked-eye change, nor can obvious naked-eye change be seen as a rule in the peripheral nerves. The grey degeneration of the posterior columns can be followed as far as the nuclei of Goll and Burdach, and the atrophy of the terminal fibres around the cells of these nuclei produces a change in the shape of the medulla in these regions owing to the sclerosis resulting in consequence of the atrophy. In some cases of tabo-paralysis the atrophy is limited to the posterior columns; in others and more rapid cases the whole cord is wasted, and there is comparatively little glia proliferation. In some cases of tabes dorsalis which have terminated in paralytic dementia, and especially when epileptiform seizures have occurred, there is not only a naked-eye sclerosis of the posterior columns, but also a shrinking and sclerosis of one or both lateral columns; if the seizures have been unilateral the fibre degeneration and atrophy is on the same side as the seizures.

Microscopic examination. The spinal cord lesions of tabes and tabo-paralysis as regards the affection of the posterior roots and posterior columns are, as a rule, identical. In both diseases there is the same system of exogenous fibres affected in the same situations in the spinal cord. The morbid process selects first certain groups of fibres and spares others, but eventually, in advanced cases, destroys nearly all the exogenous fibres. Many symptoms and signs, and especially the distribution of anaesthesia in the cases of tabes and tabo-paralysis (in which the cutaneous sensibility can be ascertained), indicate that certain segmental regions of the spinal cord are earliest affected; and systematic microscopic examination of the spinal roots and of the spinal segments show certain regions are more affected than others—viz. lower lumbar and sacral, mid, upper dorsal, and lowest cervical.

Posterior roots. Microscopic examination almost invariably shows (whether the case is early or late) that degeneration or disappearance of fibres has taken place, relatively proportional to the atrophy of the exogenous system, in the lumbo-sacral region of the cord. Sections, longitudinal and transverse, stained by Marchi's fluid very seldom show any degenerated black fibres, and they present none of the appearances of Wallerian degeneration of nerves. When stained by Pal or Weigert's methods, some fibres which stain blue may be normal in appearance, others appear very much attenuated, as if the myelin sheath had atrophied; moreover, they stain a fainter blue owing to the thinning of the myelin. The bundles of posterior roots, which are normally considerably larger than the anterior roots, are much smaller and diminished in size, in proportion to the outfall of fibres. The interstitial tissue is sometimes increased, although there is not always a proliferation; the vessels are often seen engorged with blood, but not more so than those of the undegenerated anterior roots. The walls of the arteries and arterioles are often normal; when thickened owing to arterio-sclerosis, it is generally in a subject over 50, and the thickening is not limited to the posterior roots, but affects also the arteries of the comparatively healthy anterior roots. I do not remember seeing one which presented the typical character of recent syphilitic arteritis, though it is by no means uncommon to find a condition of arterio-sclerosis, which is probably indirectly of syphilitic origin.

The appearance of the posterior root-fibres presents the condition found in a nerve after section, when all the products of degeneration have been absorbed. Empty neurilemmal sheaths with proliferated nuclei, vessels, and connective tissue are the only structures found, as a rule, in the roots which have undergone degenerative atrophy. Some fibres still possessing a myelin sheath may be found amidst this tissue, if the root-fibres are not completely destroyed. Stained by Marchi's method the myelin does not show black globules like a degenerated nerve-fibre, but occasionally a fine black dust scattered through its substance, as if a slow molecular Wallerian change was taking place; or the myelin may be simply diminished in amount, and attenuated to various degrees in some places, while of fair thickness in others. Where the myelin is diminished, several nuclei of the neurilemmal sheath can be seen, as if the atrophy of the myelin had been followed by, or associated with, nuclear proliferation. Phagocytes containing blackened myelin are seldom seen, except in some few cases of rapid tabo-paralysis.

Although the degeneration of the sensory posterior spinal neurones of tabes is intradural, for the degenerative atrophy extends back as far as the spinal ganglion, yet we shall see later, that the atrophic process commences with the spinal cord. Before dealing more in detail with the distribution of the intra-spinal degeneration of the exogenous system of the posterior columns, and the additional degeneration of other systems which may occur, we shall consider the changes which may be observed in the spinal ganglion itself.

Spinal ganglia. The attractive theory of Marie based upon the neurone doctrine that the degeneration is due to a nutritional change in the posterior spinal ganglion cells is one which explains many facts, but the argument which is advanced against it is this: if it be so, why are not nutritional changes manifested histo-chemically by the Nissl method? Some authorities, Wollenberg, Ströbe, Thomas and Hauser, and others, have described changes in the posterior spinal ganglion cells; on the other hand, numerous observers have asserted that the changes which have been found were insufficient to account for the changes in the roots and cord. The examination of a large number of sections of posterior spinal ganglia, from the majority of the fatal cases I have recorded, has not satisfied me that the changes which I observed were sufficient to account for the disease. The changes in the cells were indeed insignificant as compared with the degenerative atrophy of the fibres emerging from the ganglion. In many instances, some of the cells were shrunken, the nucleus eccentric, and even the capsules empty, as if there had been a complete atrophic decay; but the majority appeared fairly normal, both the large, medium, and small sized. Excess of pigment was frequently seen, but the same might be found in the cells from any old person.

Peripheral nerves. It may be stated generally that the peripheral cerebro-spinal nerves like the spinal cord of advanced cases of tabo-paralysis are smaller in transverse section than normal, and without any microscopic examination it would be said that they are atrophied.

A section longitudinally through the spinal ganglion with a portion of the roots and issuing nerve attached, stained by Weigert's method, and examined microscopically, leaves no doubt in the mind of the observer that the disease is essentially one of the intradural portion of the spinal afferent neurone. He will observe the anterior root, consisting of normal fibres, lying by the side of the degenerated and completely atrophied posterior root, and he will conclude that no mechanical process of strangulation at the point of exit from the dural sheath will explain this fact. At the proximal end of the ganglion he will see very few fibres, and these much attenuated; whereas, at the distal end he will observe the fibres emerging of normal appearance, and as well stained as the fibres of the anterior roots. Again, he will consider that it is impossible for a vascular change within the ganglion to account for the distal portions of the T-shaped processes of the cells to have escaped.

I have, however, noticed in longitudinal sections of the posterior spinal ganglion with a long attachment of the ventral and dorsal roots, that the myelin sheath of fibres, which still possess the property of staining blue by the Pal or Weigert staining, becomes sometimes more attenuated and fainter as one proceeds away from the ganglion towards the cord. Again, one may find the peripheral fibres proceeding from the ganglion quite healthy in appearance (as regards myelin staining) in an advanced case of tabes, and yet the remote sensory fibres degenerated.

Examination of the peripheral nerves. Transverse and longitudinal sections in some advanced cases may show changes, but in no degree sufficient to account for the symptoms, or in any way proportional to the atrophy of the posterior roots. In a case (vide Plate XXVII), however, where there was extensive muscular wasting of the small muscles of the hands with reaction of degeneration, and atrophy of the anterior horn cells and anterior roots, there was naked-eye degenerative sclerosis of the median and ulnar nerves. This was quite apparent when the nerves (after hardening in Müller) were cut in transverse sections, and showed a marked atrophy of fibres with substitution fibrosis. The sciatic nerve likewise showed a similar change; but there was not the same atrophy of the anterior horn cells, as seen in the cervico-dorsal region; the cells in the lumbo-sacral region, on one side more than the other, showed a process of regressive atrophy; the cells were there, but their processes were broken off, and there was not the same degeneration of the anterior roots. The process was very probably the same, but not so advanced, as in the cervico-dorsal region; still the outlying portions of the neurones had undergone atrophy.

The cause of this degenerative atrophy will be further discussed later; also, considerations will be advanced as to why the central projections of the posterior spinal neurones should be degenerated when the distal remain unaffected; it is generally admitted that the peripheral terminations of the nerves in skin and muscles are more likely to show degenerative atrophy than the portions nearer the cells of origin. My examinations of the skin are not sufficiently numerous, nor do I think the methods usually employed are sufficiently reliable, to make any definite statements with regard to the importance of the changes; yet the examinations I have made were sufficient to convince me that in early cases there was little or no appreciable degeneration, while in the late cases, although there was undoubtedly atrophy and disappearance of fibres, the changes were of far less importance as compared with changes in the posterior roots. This coincides with the obvious segmental root distribution of sensory disturbances observed during life.

The degenerative changes of the intraspinal portion of the sensory protoneurones. In twenty-eight spinal cords of cases of tabes and tabo-paralysis which I have examined, the three sets of coarse fibres entering the cornu-radicular zone, and proceeding respectively to the root zone of Charcot, to the cells of Clarke's column, and to form Goll's column, were affected; not always, however, to the same extent, for the relative degree of degeneration of each of these three systems of fibres depends upon the relative degree of degeneration of particular roots. For, although every root in the lumbo-sacral region, where the morbid process in the great majority of cases commences, contains fibres belonging to each of the three systems, namely, spinal, cerebellar, and cerebral, yet some roots, according to the functions of the structures innervated by them, contain many more cerebral afferent fibres than cerebellar and vice versa. The appearance of Clarke's column at the level of the second lumbar segment and its disappearance at the second dorsal is an indication of the important relation of this system of neurones to the muscles of the trunk and the muscles used in maintaining the static position. Nevertheless every posterior root in all probability contains fibres which carry impulses upwards by way of Clarke's column and the cerebellar tract to the middle lobe of the cerebellum.

I have shown[1] experimentally that the very large first sacral posterior root of the monkey possesses a large number of fibres belonging to all three systems, but especially to the cerebral system; this root is distributed to the whole of the sole of the foot and its deep structures; it is, therefore, of great importance in conveying sensory impulses essential for the maintenance of gait and station.

Examination by the Marchi method of the different segments of the cord, after section of this posterior root in the monkey on one side, showed: (1) That a very large number of fibres of this root enter into the formation of the column of Goll, apparently nearly half of the fibres of this tract in the cervical region being degenerated, and the degeneration uniformly distributed over

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[1] 'Die zuführenden Kleinhirn-Bahnen des Rückenmarks bei den Affen.' F. W. Mott. Monatschrift für Psychiatrie, vol. i.

the whole triangle; (2) that a considerable number of fibres enter the root zone of Charcot, in the first sacral segment especially, but also in the segments above and below; (3) that at the third lumbar segment the only degenerated fibres found in the posterior column consist of a band which extends from the mid line back to the periphery, leaving internal to it a small triangle undegenerated, probably tail fibres (vide Fig. 47).

As soon as Clarke's column begins to appear at the upper part of the second lumbar segment, the anterior half of these degenerated fibres runs forward to end around its cells; and not until about the eleventh dorsal segment do these degenerated fibres cease to be found entering Clarke's column. The degenerated fibres of Goll's column then form a definite posterior internal triangle, which can be followed up to the medulla. This experimental evidence shows what a very important part this root, which is so often affected in tabes, must play in the production of ataxy of gait and station, by the cutting off of guiding sensations to the cerebrum and cerebellum.

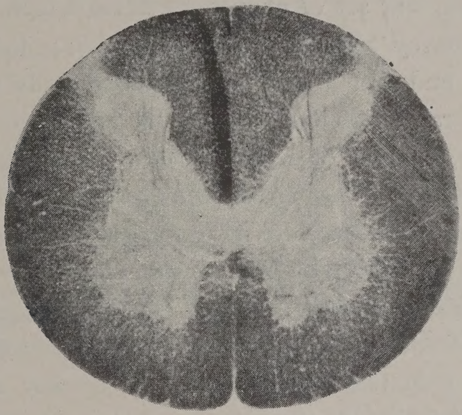


FIG. 47. Photomicrograph of section (third to fourth lumbar segment) of spinal cord of monkey, after section of the first sacral nerve on one side. The black band seen represents the degenerated fibres belonging to the cerebellar and cerebral systems. It will be observed how very extensive this degeneration is. As soon as Clarke's column appears at the first lumbar a large number of these black fibres run forward to end in a plexus around the cells, leaving the fibres of Goll's column as a compact triangle posteriorly.

The padded foot or complete anaesthesia of the sole, with abolition of cutaneous reflex, means, therefore, abolition of the fibres for cerebral and cerebellar impulses, and explains the increase of the ataxy when the sole of the foot is anaesthetized by cold. The ataxy, I am of the opinion, has a decided relationship to the atrophy of the plexus around the cells of Clarke's column, and I have not seen any case in which this was pronounced without marked ataxy, whereas I have seen other examples in which this was not pronounced, although Goll's column was markedly affected. Several cases showed comparatively little cutaneous anaesthesia, and yet there was very marked ataxy.

There is another set of exogenous fibres which, according to Bechterew, convey sensations from the skin; these fibres are small in size and run a very short intramedullary course. In the lumbo-sacral region they occupy at least two-thirds of the zone of entry, or zone of Lissauer, and give origin to numbers of fine collaterals which arborize around the cells of the posterior horn. They do not, therefore, take part in the formation of the posterior column, and it may be presumed that these fibres convey sensory impressions from the skin. This is more easy to understand if we accept the hypothesis that the same fibres conduct pressure and pain impressions, but that quality and intensity of stimulus determine the sensation produced. In syringomyelia, however, we have sensory dissociation, touch being perceivable, but heat, cold, and pain not, for the reason that the grey matter is destroyed and the exogenous fibres of the posterior column are intact; it may be presumed then, that the grey matter conducts painful sensations, and the posterior columns conduct tactile; but the segments of grey matter of the posterior horn are united by long and short ascending and descending association fibres, and their preservation, at any rate for a considerable time, may account for the delay, yet eventual transmission of sensory stimuli to the brain in tabes.

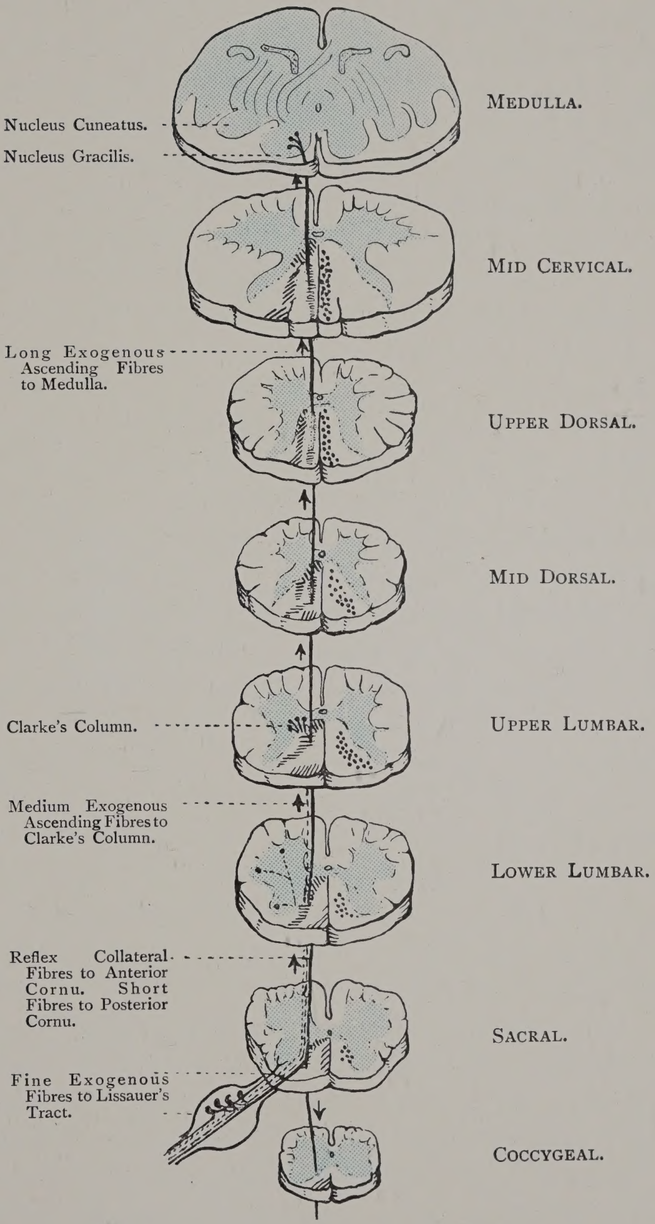
The fine fibres of Lissauer's tract are not affected in all cases of tabes; in 11 cases out of 28 spinal cords examined by me the fine fibres of Lissauer's tract were but slightly affected, whereas in all cases there was a marked affection of the cornu-radicular zone. A correlation of sensory skin disturbance observed during life and atrophy of Lissauer's tract of fibres was observed by

PLATE XXV.

Diagram after Ferrier to show the mode of origin of the afferent exogenous systems from the posterior root ganglia. Endogenous tracts, descending = ////// , ascending = \\\\\\; areas of tabetic degeneration are indicated by dots.

To face p. 398.]

PLATE XXV.


Nucleus Cuneatus.
Nucleus Gracilis.
Long Exogenous Ascending Fibres to Medulla.
Clarke's Column.
Medium Exogenous Ascending Fibres to Clarke's Column.
Reflex Collateral Fibres to Anterior Cornu. Short Fibres to Posterior Cornu.
Fine Exogenous Fibres to Lissauer's Tract.
MEDULLA.
MID CERVICAL.
UPPER DORSAL.
MID DORSAL.
UPPER LUMBAR.
LOWER LUMBAR.
SACRAL.
COCCYGEAL.

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me in a number of cases. The path of sensibility of deep structures from muscles, tendons and ligaments, and structures about joints is especially affected in tabes, and occasionally, as Redlich and others have observed in early cases terminating fatally, acute changes may be found affecting the intramedullary portion of the exogenous neurones and not the roots. An example of this occurred in my practice where a tabo-paralytic patient did not long survive the onset of spinal symptoms, and I found upon microscopic examination of the spinal cord a number of recent degenerated intramedullary fibres in the lumbo-sacral region limited to (1) the cornu-radicular zone (afferent spinal reflex); (2) the fibres entering Clarke's column (afferent cerebellar system); (3) the fibres forming Goll's column (afferent cerebral system). These three systems of fibres, the integrity of which is essential for co-ordinate reflex, progression, and posture, are always affected in tabes. (Vide Plate XXV taken from Ferrier's Lumleian lectures.)

There was no meningitis which could account for this intramedullary degeneration; moreover, if this were the cause, it should not be selective in sparing the fine fibres of Lissauer's tract. It will be gathered that my observations have led me to the conclusion that the degeneration of the exogenous systems of fibres is a primary dystrophy of the spinal protoneurones, commencing in the collaterals and intramedullary terminals and extending back to the ganglion cells in the posterior spinal ganglion, and the terminals of the peripheral nerve-fibres is a later change. But it is necessary to mention other views, e. g. Von Leyden and Goldscheider regard the dystrophy as commencing in the peripheral nerve-endings. It is assumed by the supporters of the peripheral origin of tabes, that changes organic or functional in the spinal ganglion cells may be due to neuritic or other processes in the peripheral nerve-endings, and this results in secondary degeneration of the posterior roots and posterior columns of the cord. Other pathologists seek to explain the origin of the tabetic process by inflammatory conditions of the meninges affecting the posterior roots. 'Nageotte holds that in tabes there is a diffuse chronic meningitis which has all the characters of syphilitic origin, namely infiltration with lymphocytes and plasma cells, especially around the veins, a meningo-myelitic affection of the periphery of the cord, medulla, and even the cortex cerebri.' Ferrier in his Lumleian lectures says this theory of tabes is open to the same objection as Redlich and Obersteiner's theory, in that the meningitis which it postulates is not a constant phenomenon, and is more frequently absent than present, and when it exists is more often of the character of a secondary thickening than an inflammatory process; moreover, it has been found in early stages of tabes 'that the intramedullary degeneration of tabes is often well marked when the posterior roots exhibit no appreciable change and no indications of a local neuritis'. The escape of the anterior roots, which we do not find in syphilitic meningo-myelitis is, to my mind, a fatal objection to Nageotte's theory.

Redlich and Obersteiner maintain that at the point where the posterior roots penetrate the *pia mater* there is a constriction which constitutes a *locus minoris resistentiae*, and that in consequence of meningeal inflammation and constriction as well as by thickening of the closely adherent blood-vessels, the posterior root-fibres become as it were strangled. Hence intramedullary degeneration occurs, followed at a later stage by a retrograde degeneration of the extra-medullary posterior root-fibres (vide Fig. 48). The occurrence of degeneration elsewhere, such as in the optic nerve, ciliary ganglion, and sympathetic system, are all strong arguments against the meningitic theories.

It is probable that the absence of the neurilemmal sheath of the intramedullary fibres, together with other anatomical conditions, viz. the peculiarities of the lymph circulation in the posterior columns pointed out by Pierre Marie and Guillain, play some important part in rendering this portion of the sensory protoneurones more susceptible to the action of toxins. Homen and Orr and Rows have shown experimentally that toxins originating in the periphery ascend to the spinal cord more readily by the posterior than the anterior roots; consequently in this way or by peculiarities in the lymph circulation the posterior roots and posterior columns are more liable to damage from failure of

PLATE XXVI.

From the same case as Plate XXVIII illustrating amyotrophic tabes.

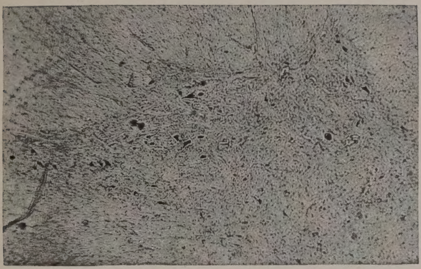
1 and 2. Low-power photomicrographs of the right and left anterior horn at the level of the eighth cervical.

3 and 4. Right and left anterior horn, level of the first dorsal. There is a marked atrophy of the anterior horn cells on both sides, but more marked on the left.

5. Amyotrophic tabes, anterior horn cells, first sacral segment, showing chronic degenerative changes, breaking off of processes, and excess of pigment. Magnification 300 dia meters.

To face p. 400.]

Plate XXVI



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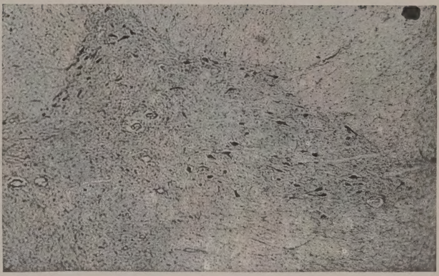

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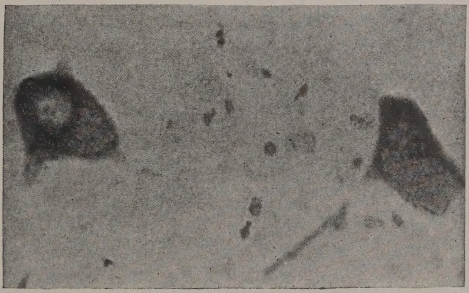

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nutrition or from the absorption of poisons. Ferrier, however, holds that it cannot be maintained that there is in tabes a posterior meningitis of a syphilitic nature, for it is not supported by the results of antisyphilitic treatment nor can lymphocytosis of the cerebro-spinal fluid be advanced as a conclusive argument in its favour.

The accompanying photomicrographs (Plate XXVI) illustrate the appearances of degenerative atrophy commonly met with in a fairly advanced case of tabes affecting arms and legs. Case 28, *Archives of Neurology*, p. 128. The patient had when a young man lost an eye as a result of injury, and at the age of 32 he became blind in consequence of optic atrophy; this was followed soon after by an attack of mania with depression, and he was admitted to Colney Hatch Asylum; the mental symptoms subsided, but *he became ataxic* and the ataxy progressed so that in a few years he was helpless in his legs and partially in the arms;

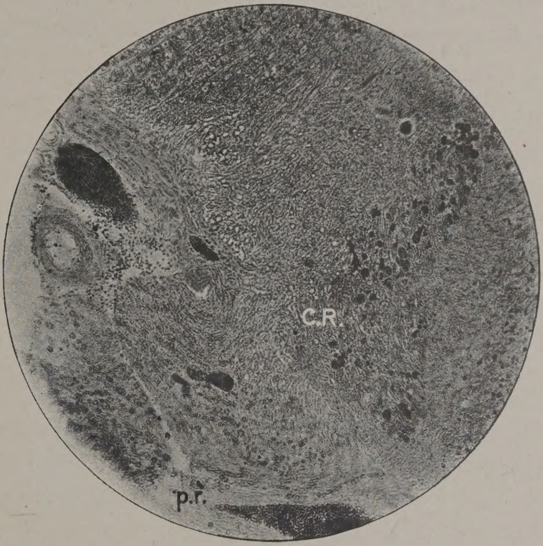


FIG. 48. Section of spinal cord, 1st lumbar, stained by Marchi's method, showing degenerative fibres in the cornu-radicular zone (C.R.). The posterior roots (p.r.) are free from degeneration; so is Lissauer's tract. There is no meningitis which would account for this intra-medullary degeneration. No cutaneous disturbance was observed during life, although there was ataxy; and the spinal reflex, cerebellar and cerebral afferent systems were all degenerated. See p. 274, vol. ii, *Archives of Neurology.*

the mental symptoms, however, did not recur and there was no progressive dementia. He lived for ten years; his body was well nourished and the limbs were not wasted. He might have lived many years longer had he not contracted institutional dysentery. The post-mortem findings were briefly as follows: Tabetic lesion of spinal cord and roots, in cervical and lumbo-sacral regions, especially; affection of both exogenous and endogenous posterior spinal systems; marked patchy pia-arachnoid thickening over pre-frontal, frontal, and central convolutions; chronic atrophy of superficial layers of fibres and cells of cortex in these regions without vascular changes. Was this a case of mania and tabes, or tabetic general paralysis with arrest of mental symptoms? I am of opinion that it was the latter.

THE ENDOGENOUS SYSTEMS OF FIBRES OF THE POSTERIOR COLUMNS

These ascending and descending systems of fibres arise from cells situated at the base of the posterior cornua; they are of varying lengths and serve to associate the sensory segments of grey matter at various levels; they degenerate in the later stages of tabes. In nine cases where there were very marked ataxic symptoms, I have obtained the following results by microscopic examination:

1. The descending endogenous system of fibres was markedly affected in six instances, and in three very markedly.
2. The ascending endogenous system (cornu-commissural of Westphal) was never completely destroyed *throughout* the cord, even in the most advanced cases, although in one or two instances it was almost absent in some regions.

In cases of endogenous system degeneration, there was invariably a very marked atrophy of the exogenous system. In nearly all the cases of tabes which commenced with optic atrophy, eventually terminating in blindness, there was no appreciable affection of the endogenous system; this, however, was not invariably the case. There was a decided relationship between the degree of affection of the endogenous systems of the posterior columns and the degree of ataxy, moderate atrophy

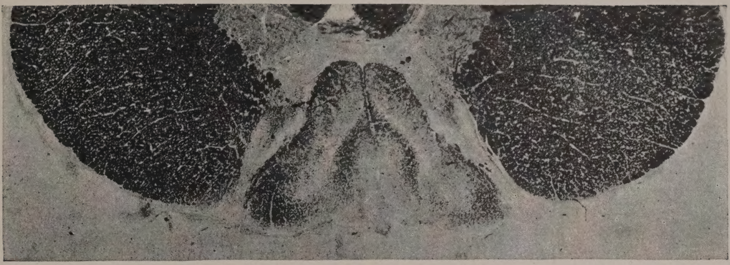
PLATE XXVII.

Photomicrographs of the spinal cord in tabes.

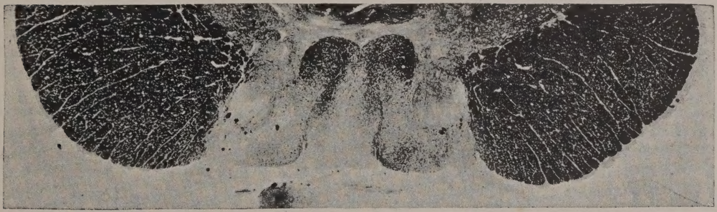
Sclerosis of the posterior columns at various levels in a case of advanced tabes, in which the patient was helpless and bedridden, but was able to use his arms. It will be observed that in the lumbar region the posterior columns are greatly shrunken, but there are still some endogenous fibres in the cornu commissural zone and oval area of Flechsig. At the tenth dorsal there is still complete degenerative atrophy of the posterior roots, the dark staining in the posterior columns being due to endogenous fibres. In the eighth cervical there is a complete atrophy of entering root fibres. The triangular-shaped area of healthy fibres are partly descending endogenous fibres, extending obliquely from the cornu commissural zone into this area. At the fourth cervical there is seen a complete sclerosis of the leg fibres of Goll's column which is separated from another area of sclerosis corresponding to the atrophied arm fibres by a triangle of stained fibres. These are partly endogenous, and partly exogenous fibres from the lowest dorsal region, where the roots were only partially destroyed.

To face p. 402.]

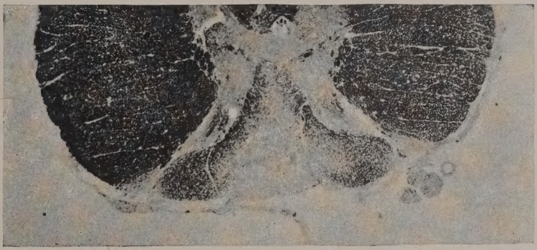
PLATE XXVII



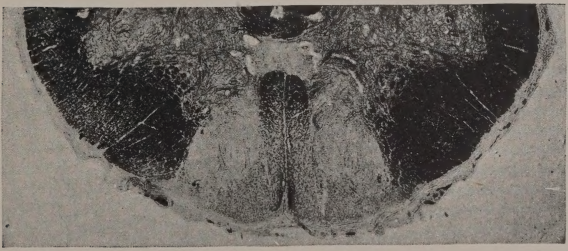
Fourth Cervical.



Eighth Cervical.



Tenth Dorsal.



Fifth Lumbar.

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PLATE XXVIII.

Photomicrographs of the posterior halves of the medulla and spinal cord from a case of tabes in which the upper limbs were affected even more than the lower. There is a complete degeneration of the fibres of the nucleus gracilis and nucleus cuneatus seen in the medulla (1 and 2). In (3), the cervical enlargement, there is a complete disappearance of all the exogenous fibres, and a great part of the endogenous fibres, except some few in the cornu commissural zone. 4. Level of the first lumbar shows almost a complete destruction of the exogenous and of the endogenous fibres. Case, p. 402.

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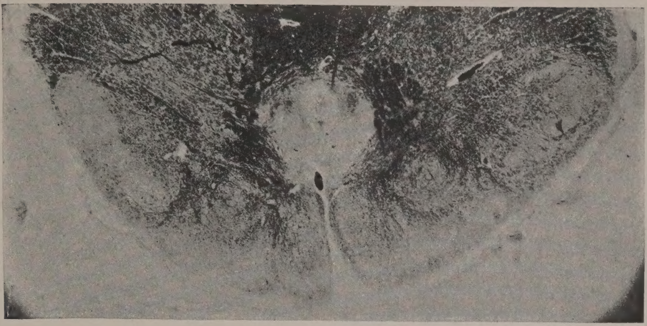

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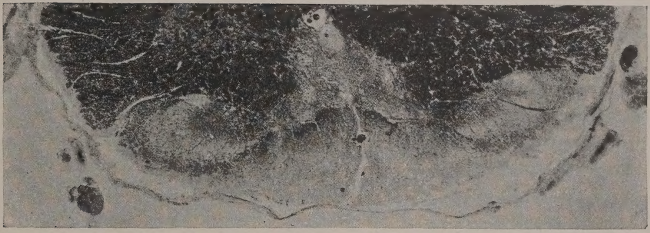

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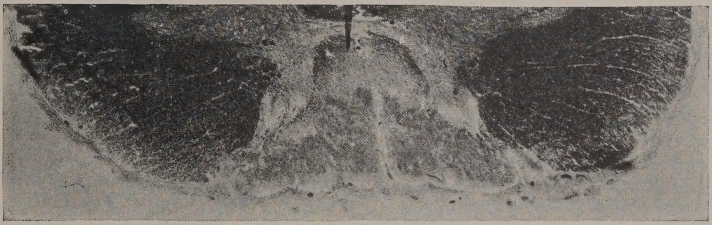

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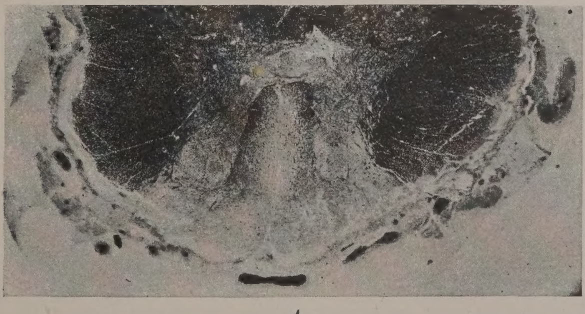

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of the endogenous systems occurring in persons who were well on in the second stage of locomotor ataxy. All those with marked or very marked atrophy were in the advanced bedridden paralytic stage. All those in the preataxic stage showed no degeneration of the endogenous systems, although there was extensive atrophy of root-fibres and especially of their intramedullary projections.

I consider that these endogenous fibres, like the exogenous systems of fibres, are of long, medium, and short lengths, and serve for the correlation of the sensory functions of different segments of the spinal cord.

Observation of many cords, in some of which, in the mid and upper dorsal regions, there was a complete atrophy of the root-fibres in cases where during life there was a corresponding loss of cutaneous sensibility of the trunk, showed still a large number of fibres in the situation of the comma tract, and the posterior internal zone extending thence along the dorsal margin of the posterior columns, and continuous at the first lumbar with a small triangle at the side of the median fissure. The fibres in this triangle, as one proceeds to lower levels, are seen to extend up the median fissure, and become continuous with the oval area of Flechsig in the lower lumbar and upper sacral regions, and this again is continuous with the median triangle of Philippe situated in the lowest sacral segments. In degenerative atrophy affecting the descending endogenous fibres, the first to disappear are those in the dorsal region, occupying the comma-shaped tract, its dorsal club-shaped projection and peripheral extension towards the median septum; the next are the fibres of the oval area and the posterior triangle, with which they are continuous (vide Figs. 49, 50, 51, and photomicrographs, Plates XXVII and XXVIII).

Muscular atrophies occasionally occur in tabes, and more often, probably, than earlier writers allowed. Cases have been described by Dejerine, Souques, Marie, Oddo, Camp, and Raymond. I have seen the following case of amyotrophic tabes:—

Case 50. A man, aged 42 at death, was admitted into the Marylebone Infirmary in 1894 at the age of 32; he had

FIGS. 49–51. Photomicrographs of sections of the posterior columns at various levels and from different cases of tabes dorsalis to show the origin and distribution of the endogenous systems of fibres of the posterior column. It is interesting to observe that there is but little flattening of the spinal cord posteriorly, for the reason that the cases were not very advanced and of long duration.

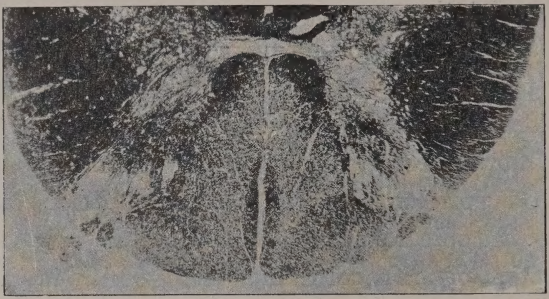


FIG. 49. Photomicrograph of third lumbar segment (Case 52), showing degeneration of intraspinal portion of exogenous fibres of posterior columns; the ascending and descending endogenous fibres are intact. The continuity of the fibres of the posterior internal zone, the septo-marginal, and the oval area of Flechsig as one tract, is well shown.

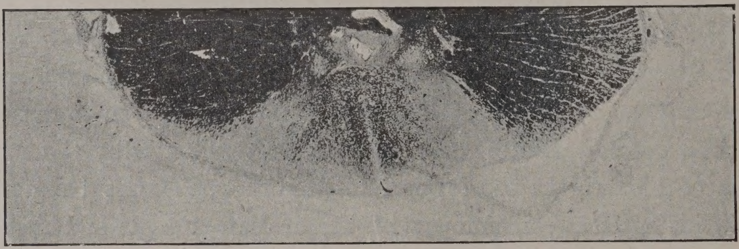


FIG. 50. Section of spinal cord at level of lowest dorsal region. There is complete atrophy of Lissauer's tract extending into the region of the direct cerebellar tract, each side of which is also atrophied. The entering root-fibres have completely disappeared. The fibres in the posterior column are mainly continuous with the two bands of fibres which encircle Clarke's column, and are in all probability endogenous. The plexus of fibres round the cells of Clarke's column is completely atrophied. The central canal is dilated.

been in the army, acquired syphilis, and had for thirteen years followed the occupation of a parcel-post sorter. Fifteen months before admission he suffered from migrainous attacks, double vision and ptosis, and lightning pains followed by weakness in the legs and arms. Upon admission he was suffering with marked right hemianopsy and nystagmus; besides the usual signs of ataxy in the lower extremities, there was great loss of co-ordination in both arms; the deep reflexes could not be obtained; there was numbness and paraesthesia of the hands but the sensibility to touch, pain, heat, and cold seemed normal.

Six months later wasting of the small muscles of the hands was observed and it was found that the small muscles of the left hand gave no reaction to the faradic current and those of the right required a stronger current than normal. Sensation to touch was blunted on the chest and arms, but there was no thermo-anaesthesia. On moving the fingers the patient could tell which fingers were moved but was unable to state what the movement was. Four years later he developed mental symptoms and died in the course of a year of tabo-paralysis.

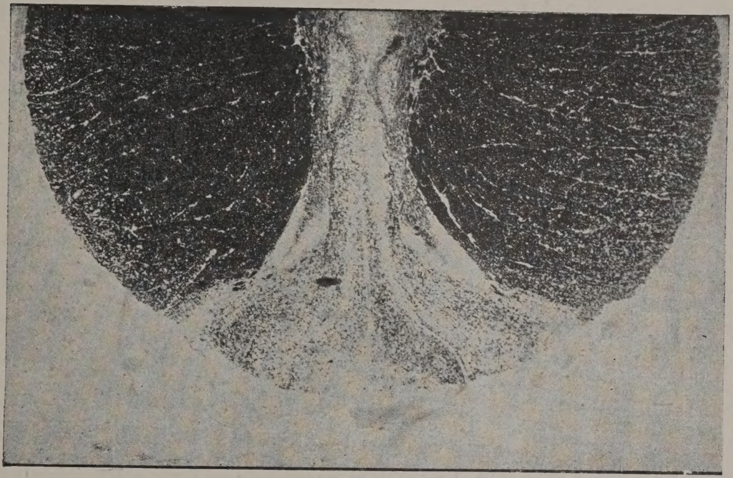


Fig. 51. Section of spinal cord at level of eighth dorsal segment. There is no flattening of the posterior column; it is even more convex than normal. There is, however, very marked shrinking and distortion of the grey matter and of the posterior column, so that the columns of Clarke are almost in apposition. The plexus of fibres around the cells is completely atrophied, but encircling the columns are two sets of fibres, one external, proceeding from the grey matter of the posterior horn, the other internal, continuous with the fibres of the postero-external zone. [Magnification 16.]

This case is interesting for several reasons, viz. its rapid course after the onset of symptoms; the affection of the arms, and this may be correlated with his occupation of a parcel-post sorter; the amyotrophy of the small muscles of the hand; the termination of the case in paralysis. These clinical conditions may be correlated with the following post-mortem findings: there was marked atrophy of the posterior roots in the cervical region with a corresponding atrophy of all the exogenous fibres in the posterior columns; atrophy of the fibrils around the cells of Burdach's nucleus in the medulla (this accounts for the arm symptoms early in the disease, which is unusual) (vide Plate XXVII). There was also atrophy of the anterior horn cells in the seventh and eighth cervical and the first and second dorsal segments, especially in the latter situation, and this may be correlated with the ulnar nerve atrophy which was found and the degenerative atrophy of the small muscles of the hands observed during life (vide Plate XXVI). The cortex showed the characteristic vascular changes and perivascular infiltrations with lymphocytes and plasma cells characteristic of early acute paralytic dementia. A full account of this interesting case may be found in vol. ii, *Archives of Neurology.*

Lastly may be mentioned the fact that J. C. Roux, inspired by Dejerine, examined the sympathetic in seven tabetics and ten other subjects dying of other diseases. In all the latter he found the sympathetic normal, while he did not fail to find in the former marked and identical changes in the sympathetic chain and the great splanchnic nerves. Roux attributes the anaesthesia of the testicle, bladder, heart, and trachea, as well as that of the stomach, to these changes. Previous observers, e.g. Charcot and Raymond, were unable to discover any abnormal appearances in the sympathetic.

BRIEF ACCOUNT OF THE PHYSIOLOGICAL PATHOLOGY OF TABES

No disease exhibits such a complex symptomatology as tabes and no disease offers such an array of unsolved neuropathological problems. The disease we have seen is essentially a dystrophy of the sensory spinal protoneurone, other conditions are more or less inconstant or concomitant. The motor neurones are intact, the electrical reaction of the muscles are normal, and their dynamic strength is not necessarily impaired. There are no degenerations of systems conducting impulses from the brain

—cortical, basal, or cerebellar. We know that every posterior root furnishes fibres to different sensory nerves of the periphery. The cutaneous surface is subdivided into zones or segments, of which each receives its sensory innervation from certain definite posterior roots. These segmental posterior root areas overlap one another, and each receives fibres from two or three contiguous roots. It will thus be manifest that the area of distribution of cutaneous anaesthesia will be quite different, when it depends upon alteration of the posterior roots and their intramedullary prolongations, from the case in which the lesion depends upon alteration of the peripheral nerves. In tabes, cutaneous sensory dissociation is the rule, especially in cases which are not very advanced; whereas it is the exception for an anaesthesia of peripheral origin to exhibit the characters of dissociation. There is, however, not only dissociation of cutaneous sensibility, but also marked subjective and objective sensory disturbances of the deep structures, which may exist independently of cutaneous disturbances. We have already referred to the fact that the fine fibres of the posterior roots probably convey cutaneous sensations, and the coarse fibres sensations from the deep structures. We have seen, moreover, that clinical observations and morbid anatomy have demonstrated that these two systems may be affected independently. The destruction of the fine fibres leads to phenomena of irritation and occasions the lightning pains, visceral crises, and paraesthesia. When a sufficient number of roots have been destroyed there is a segmental cutaneous anaesthesia.

It is the destruction of the deep fibres subserving the conduction of tactile, static and kinaesthetic impressions from joints, tendons, fasciae, muscles, and the tactile corpuscles, which occasions the ataxy. Although ataxia is caused essentially by the degeneration of the posterior roots and their intramedullary projections, yet marked ataxy does not occur until there is some degeneration of the endogenous systems; doubtless this is due to the much increased hypotonus owing to the absence of stimulus from the association which the endogenous systems effect with other parts of the cord. It must, however, be remembered that ataxy is due not only to loss of function from neuronic destruction, but to physiological overaction of structures which normally act in opposition to those which are destroyed.

The tabetic pupil. The importance of the pupil phenomena in tabes has been already emphasized, but no attempt was made to explain the characteristic reflex iridoplegia. Ferrier summarizes admirably our knowledge respecting the reflex pupillary arc and concludes: 'It is evident that there is still great obscurity as to its precise constitution and that though theoretically reflex iridoplegia may be explained by interruption of certain hypothetical centripetal paths of the light reflex, no actual pathological changes have as yet been demonstrated in the reflex iridoplegia of tabes.' After referring at length to the observations and investigations of Marina, Piltz, Anderson and Langley, and Bumke, Ferrier sums up in the following words: 'Therefore though the exact mechanism may require further elucidation the probability is that the condition which blocks the path of reflex pupillary constriction blocks also that of psycho-reflex dilatation; and that in the degeneration of the ciliary ganglion we have the explanation of the tabetic pupil.' The physiology of the ciliary ganglion is still very imperfectly understood. According to Anderson the cells are all of the sympathetic type and Marina holds that most of them are sympathetic. The ganglion has three roots, viz. the sympathetic from the carotid plexus, a short motor root from the third, and a long sensory root from the fifth. It is not, however, an independent centre, for the pupillary reflex for the pupil remains immobile after division of the third nerve.

Piltz exposed the ciliary ganglion and ciliary nerves in the dog and produced irritation of the various branches of the short and long ciliary nerves, and obtained alterations in the position of the pupil and irregularities in its outline. These experiments enable us to understand the irregular outline of the pupil, a condition so early and frequently met with in tabes and general paralysis, but do they throw any light upon the loss of the light reflex with retention of contraction upon accommodation? Is it an elective action of the syphilitic poison or can we explain it as Edinger does by the fact that this light reflex path is continually in action under the influence of every varying influence of light and shade and the psycho-reflex path is likewise continually in action under emotions of anger and fear, pleasure and pain? Reasons have already been advanced why neurones which are in greatest use should, owing to biochemical changes in the blood involving the using up of lipoids, die prematurely, and it may be that the ciliary ganglion neurones, like the posterior spinal ganglion neurones, undergo for this reason a process of dystrophy; which dystrophy causes a block in the path of unconscious *involuntary* reflex pupillary contraction as well as that of psycho-reflex dilatation. The path of accommodation is not blocked, the stimulus does not own a peripheral starting-point; it is central, voluntary, and conscious by virtue of its association with the muscles of convergence of the eyeballs; the impulse originates in the seat of volition, the cortex cerebri, and passes direct to the oculo-motor nuclei.

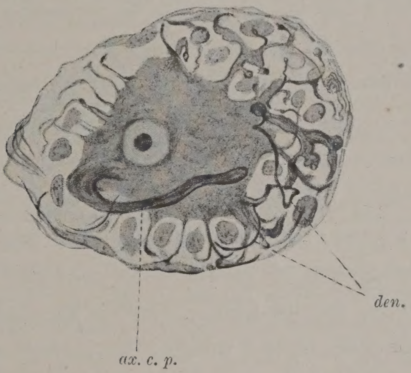


FIG. 52. A cell of the ciliary ganglion after Marinesco, showing *ax. c. p.*, a single axis cylinder process which passes out of the capsule to form a nerve fibre supplying the iris. The dendrites (*den.*) are seen as branching processes of the cell, which terminate on the surface of the endothelial capsule.

Marinesco has described and figured the cilio-spinal ganglion cells as consisting of a nucleated mass of protoplasm from all sides of which are irregularly coiled protoplasmic processes contained within the nucleated capsule of endothelial cells; there is one process, the axon, which penetrates the capsule, and it may be assumed that this becomes a sympathetic nerve-fibre which terminates in the unstriped muscle of the iris (vide Fig. 52). The short branching protoplasmic processes corresponding to the dendrons and dendrites of a motor spinal ganglion cell end on the surface of the capsule. It can easily be understood that a degeneration of the dendrites of the cilio-spinal ganglion cells would not be attended by any very marked changes in the appearance of the cells, not more than the shrinkage and chromatolysis which has been described by Marina. Moreover, we know that some cases occur, especially of general paralysis, in which the light reflex is present at first, then becomes sluggish and finally disappears, and the presence of the light and pain reflexes may for a considerable time be obtained if the intensity of the stimulus is adequate.

It may be assumed that there are two functionally different groups of cells in the central nervous system, viz. those presiding over the sphincter and those presiding over the dilator pupillae, and they have, as the respective muscles have, an antagonistic action. One group of cells presiding over the sphincter is controlled by the group of small cells constituting the Edinger-Westphal nucleus of the motor oculi; the other group by the group of small cells in the intermedio-lateral tract at the level of the second dorsal segment constituting the cilio-spinal centre. The former sphincter group controls the light reflex, the latter dilator group the pain and psychic reflex. But inasmuch as these intra-capsular dendrites of the ciliary ganglion form a connecting link or synapsis in the chain of neurones which associates stimulus of the receptor with action of the effector (sphincter and dilator pupillae) their decay would be followed by disappearance of those reflexes. But how can we explain the persistence of the accommodation reflex if this is the path of conduction to the sphincter? Either we must assume that the stimulus of accommodation and fixation, associated as it is with convergence, induces a much more powerful stimulus arising in sensitive structures of the eyeball, or it must be assumed that the light reflex is absent owing to an interruption in the path to the Edinger-Westphal nucleus, either a degeneration of fibres in the optic nerve or more probably atrophy of their terminal arborizations

Plate XXIX.

Scheme to illustrate the pupil reaction, after Bernheimer. The black arrows represent the optic radiations passing from the external geniculate bodies to the respective occipital lobes. In the middle line, just above the aqueduct of Sylvius, five areas are represented; three of these areas, representing nuclear groups of the oculomotor nerves, give off efferent fibres which pass to the ciliary ganglion, and thence fibres pass from the ganglion to the pupil. It is by means of these fibres that the pupil contracts under the influence of light, and in accommodation for a clear vision of a near object. But accommodation is accompanied by convergence and the action is bilateral. The neurones which affect accommodation are represented by the dotted area in the middle line. Its action then is to shut out light under the influence of the will. The two black areas represent the oculomotor neurones concerned in the light reflex, and it is not under the influence of the will; it is a simple reflex and fibres can be seen proceeding from both optic nerves to both nuclei. These fibres, represented by blue and red lines, pass through the corpora quadrigemina and it is probable that there are intercalary neurons between the terminal arborizations of the optic fibres and the nuclei. Lesions of the optic nerve, the retina, the optic tract, and the geniculate bodies would produce not only an interference with the light reflex, but also various visual deficiences according to the seat of the lesion, and according to this scheme the explanation of the loss of the light reflex without other failure of vision can only be explained either by the supposition that there are special optic fibres connected with the light reflex, and these undergo a primary degeneration, or that there is a lesion of the corpora quadrigemina. A loss of the light reflex and of accommodation would indicate a nuclear lesion; it may be due to arterial disease, as shown in Fig. 4, p. 69, or it may be a primary degeneration, as in the ophthalmoplegia externa and interna of tabes.

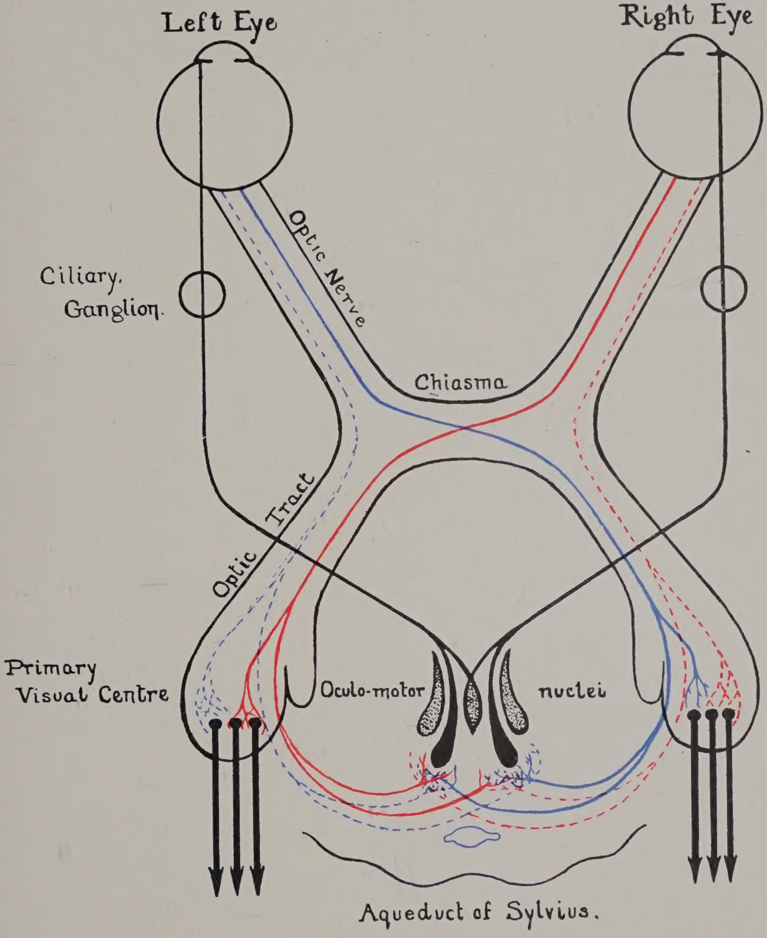
This diagram, moreover, explains the consensual light reflex, for it will be seen that each nucleus of the sphincter iridis is connected with fibres from both eyes, consequently when *one* eye is shaded, both nuclei receive a diminished light stimulus, and as a result there is dilatation of the *two* pupils. It also shows that it is impossible to have accommodation affected in one eye and not in the other, because there is a common nucleus for the two eyes, which always acts in conjunction with the nuclei that bring about convergence.

A unilateral lesion of the retina or the optic nerve of one eye not primarily degenerative might cause a loss of the direct light reflex and of the consensual reflex of the opposite eye.

Bilateral lesions of the retina or of the optic nerves might cause loss of the direct and consensual light reflex in both eyes.

A lesion of the chiasma, if sufficient to destroy it, would lead to blindness of both nasal halves of the retinae, and therefore bitemporal hemianopsy. A lesion of the optic tract would cause homonymous hemianopsy.

To face p. 410.]


Left Eye
Right Eye
Optic Nerve
Ciliary. Ganglion.
Chiasma
Optic Tract
Primary Visual Centre
Oculo-motor nuclei
Aqueduct of Sylvius.

in the corpora quadrigemina or a degeneration of the association neurones which connect them with the Edinger-Westphal nucleus.

If it be assumed that an atrophy of the ‘dendrites’ of the ciliary ganglion constitutes an essential portion of the lesion productive of the pupil phenomena of tabes and general paralysis, then we may correlate the process with the posterior spinal protoneurone dystrophy; for it may be considered that the neurofibrils which form the axon of the spinal ganglion proceed to the periphery forming the peripheral nerve-fibre, while the neurofibrils passing out of the opposite pole of the cell constitute the dendron with its terminal intramedullary dendrites; and for the same reason that the dendrites of the ciliary ganglion atrophy, these dendrites first undergo decay and atrophy, the process extending back only as far as the ganglion cell. It is necessary to remember that in embryonic life the posterior spinal neurone was a bipolar cell and the T-shaped process of the mature posterior spinal neurone has been gradually formed, so that really half the fibrils of the stem of the T-shaped process are dendritic fibrils. These dendritic fibrils are the *locus minoris resistentiae* of the spinal protoneurone, and therefore are the first to perish; the distance from the nucleus of the cell and the absence of a neurilemmal sheath are probably important reasons why this portion of the protoneurone should be the seat of least resistance and of earliest decay.

An ataxic, on closing his eyes, manifests instability of station—Romberg’s symptom. Normally, equable reflex spinal and cerebellar tonic contractions fix the joints of the lower limbs, but when the afferent impressions from the deep structures of the limbs and from the soles of the feet are cut off by degeneration of the lumbo-sacral posterior roots, the ataxic patient has to rely upon impressions from the semicircular canals and visual sensations for the maintenance of balance, by tonic contraction of opposing groups of muscles. When he closes his eyes, owing to the absence of these guiding sensations he is unable voluntarily to reinforce by attention this tonic contraction; consequently, the source of compensation for maintaining equilibrium is removed and swaying takes place, which, by the sensation from the semi-circular canals, warns him of his danger of falling by the change in his state of consciousness of position, thus enabling him by attention and an effort of the will to recover himself. Romberg's symptom is an early phenomenon of tabes, and may exist without any cutaneous anaesthesia ; it is due to the interruption of the subcortical reflex spinal and cerebellar circles by degeneration of those neurones with coarse fibres from deep structures ; it is especially related to the atrophy of the plexus of fibrils around the cells of Clarke's column ; that is to say, there is an interruption of afferent impulses of the cerebellar circle, vide Fig. 53.

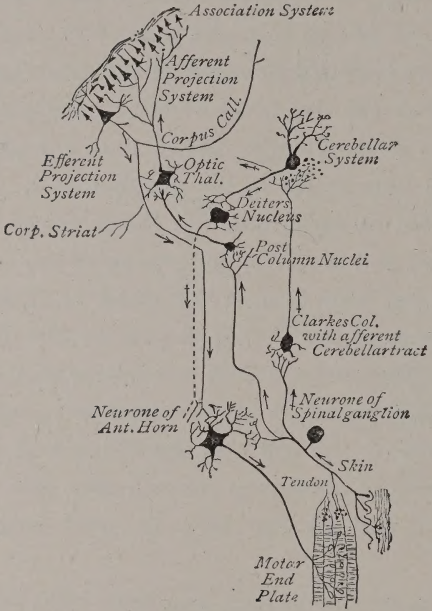

Association System
Afferent Projection System
Corpus Call.
Cerebellar System
Efferent Projection System
Optic Thal.
Deiters Nucleus
Corp. Striat
Post Column Nuclei
ClarkesCol. with afferent Cerebellartract
Neurone of Spinalganglion
Neurone of Ant. Horn
Skin
Tendon
Motor End Plate

FIG. 53. Diagrammatic representation of the three nervous circles, cerebral, cerebellar, and spinal.

One of the earliest signs of tabes is loss of tonus in the dorsal flexors of the foot ; consequently, foot-drop occurs. If the patient, while lying on his back in bed, be told to flex his hip and knee as in forward progression, it will be observed that the synergic dorsal flexion of the foot with hip and knee does not take place. By the aid of vision and attention he can produce the flexion, but it involves continuous attention, and even then it is not synergic, but follows the hip-flexion. In walking the principal movement for progression is flexion of the hip, but the range of movement would be limited unless there was an associated flexion of the knee and dorsal flexion of the foot.

An ataxic patient requires a stick or two sticks to widen his base of support, in order that he may so adjust his body that the line of the centre of gravity may fall within the basis of support, and that he may look at his feet and guide their movements. Thus, by cortical processes involving continuous attention he compensates for the failure of the normal subconscious afferent guiding sensation of the three circles, cerebral, cerebellar, and spinal. Fränckel's system of treatment by exercise of the ataxic limbs should be especially directed towards restoring this synergic action of flexion of hip, flexion of knee, and dorsal flexion of foot.

In both locomotor ataxy and general paralysis, there is a failure in co-ordination; but the cause is different; in the former, the coarse reflex and semi-automatic spinal adjustments are at fault; in the latter, it is the fine cortical adjustment.

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CHAPTER XI

NERVOUS DISEASE IN CONGENITAL SYPHILIS

PARACELSUS asserted that syphilis was in the blood and a pathogenic substance was transmitted to the foetus in conception. Congenital syphilis was described by Ambroise Paré, who in 1633 wrote: 'Souvent on voit sortir les petits enfants hors le ventre de leurs mères ayant cette maladie, et tôt après avoir plusieurs pustules sur leur corps; lesquels estant ainsi infectés baillent la vérole à autant de nourrices qui les allaitent.' Astruc and Boerhaave accepted the existence of hereditary syphilis, but owing to the influence of John Hunter's teaching this doctrine fell into disrepute until the facts of hereditary syphilis were established and placed upon a firm foundation by the works of V. Bärensprung, Wagner, Colles, Virchow, Fournier, Hutchinson, Barlow, Bury, and others. The two last-named authors state: 'It may, indeed, now be said in contrast to the early views that nearly every variety of nervous affection of acquired syphilis has its parallel amongst congenital examples; albeit there are indications of a few broad differences which may be made out as to relative frequency alike of lesions and symptoms between the two groups.' Curiously enough, Sir Jonathan Hutchinson, in his article on Hereditary Syphilis, Twentieth Century Practice of Medicine, devotes only nine lines to the diseases of the nervous system, and he states, moreover, 'It has never occurred to me in any single instance to identify the subject of this inheritance in a sufferer from tabes or general paralysis.'

It seems to be proved that syphilis acquired in infancy after birth may be followed by the same results as its acquisition *in utero* or its sperm or germ inheritance. Welander, of Stockholm, records the case of a boy who had acquired syphilis from his nurse when three months old; at the age of 13 he suffered with interstitial keratitis and nodes, moreover the teeth were characteristic. Eudlitz has also recorded a case of a male child who at the age of 2 months acquired syphilis from his mother, who had herself been infected by a nursling ; at the age of 23 he was shown at the Paris Society of Dermatology ; he was small in stature, beardless, and with infantile genital development and characteristic teeth. He had been under Fournier's care for cerebral syphilis. In an overwhelming number of cases of heredo-syphilis the transmission of the disease to the offspring is directly attributable to the father. The woman in the majority of instances is infected by the man before conception or in conception, so that the child in such cases may acquire the virus both from father and mother. This is termed mixed transmission. In such conditions the offspring is more likely to be infected than when only one parent is syphilitic. According to Fournier, the transmission of the disease occurs in 92 and the mortality of the offspring in 68·5 per cent.

A woman can, however, conceive by a syphilitic husband without becoming herself infected ; the foetus is then only syphilitic by the father, but the mother may subsequently acquire the disease from the syphilitic embryo 'choc en retour' ; this, however, does not necessarily follow, for the offspring may be syphilitic and the mother escape ; moreover, although she can suckle her syphilitic offspring without acquiring the disease, yet if a healthy wet nurse suckle the child she will acquire syphilis. The explanation of these facts is that the mother by gradually increased doses of the toxin from the syphilitic embryo in its development has acquired an immunity (Colles's Law). See also vol. i, p. 284.

Another condition which I have frequently met with is that the father and mother are at first both healthy and have healthy children ; then during a pregnancy the husband goes astray and acquires syphilis. The result of married life is that there now occur a series of miscarriages, still births, dead children, and diseased children. But under such circumstances it may happen that the woman is infected while she is already gravid with a healthy embryo ; but the syphilitic husband's sperm does not necessarily infect the developing embryo ; the mother may, however, be infected directly from the primary sore or from secretions, and in rare cases the child may then be born healthy but immune to the disease, for it can be suckled by the syphilitic mother or a syphilitic wet nurse without contracting the disease. This is termed the law of Profeta. Children born of syphilitic parents are said to be always immune against syphilis; this, however, is disproved by the fact that congenitally syphilitic subjects occasionally acquire syphilis in later life. Finger, Ogilvie, and others, indeed, have published exceptions to Colles's law: cases where the mother contracted chancre of the nipple by suckling her syphilitic offspring. But the experimental inoculation of the mothers of syphilitic children by Finger and Neisser with negative results favours this law of immunity; moreover, it accords with Fournier's experience, for he states that he has never seen a case of exception to Colles's law. Moreover, Sir Jonathan Hutchinson says: 'My own experience does not supply me with a single exception to Colles's law.'

There is a good deal of evidence to show that infection often takes place by the semen. Hochsinger records observations on seventy-two families in which there was paternal syphilis but the mothers showed no signs of syphilis during periods of four to nineteen years, although they were repeatedly examined (fifty cases were under observation for more than six years). The seventy mothers gave birth to 276 children—110 still-born, 166 syphilitic, and 31 healthy. The healthy children were all the last born except in 4 cases. I have met with many cases of undoubted heredo-syphilis with most pronounced and unmistakable stigmata, in which the mother has never suffered in any way nor did she show any sign or give any history of infection. The following is an extremely interesting example illustrating this fact:—

Case 50. E. H., aged 34, came to Charing Cross Hospital accompanied by her elder sister. She complains of pains in the limbs; she is very deaf, especially on the left side; she has typical Hutchinsonian teeth. Her sister also has typical notched pegtop-shaped central incisors and old keratitis. The sister, a married woman, gives the following history: Her mother had three premature births, then two children born dead, then one which lived sixteen months. She came next, and the patient, E. H., was born a year later. The married sister also informed me that she herself had had but one child, which was a delicate infant; it had snuffles and died at the age of six weeks. The patient, E. H., has been paralysed on the left side since early infancy. It was discovered only by her not being able to walk or use the hand. When quite an infant she had a rash on the skin and the eyebrows came out. Later in life it was noticed that she was deaf in the left ear. The left arm and leg are wasted, and the bones smaller. She has no contracture. There is a triceps contraction and marked patellar clonus, but no ankle clonus. This was undoubtedly a case of congenital syphilitic brain disease causing hemiplegia. The mother came to see me and said that she had never ailed in any way, and I could find no evidence of syphilis on the body. The family history is the specially interesting feature in this case, as showing the effects of acquired syphilis upon the offspring, and also the possibility of transmission to the third generation.

Seeing that Levaditi, Bab, and others have seen spirochaetes in the ova, it is possible that the syphilitic contagion may remain in a resting intracellular stage; but when the ovum escapes and is fertilized the syphilitic virus again becomes active, although its virulence is greatly modified and attenuated. This transmission to a third generation is a mere supposition unless, however, we can be absolutely certain that the father was not syphilitic. I could, however, obtain no history of syphilis from the father in the case above recorded. Sir Jonathan Hutchinson is most sceptical of transmission to a third generation; he says: 'Nor have any facts been placed upon record which are worthy of much attention as supporting the belief referred thereto.' An excellent critical summary of cases has been given by Dr. G. Ogilvie, 'British Journal of Dermatology,' 1897.

I have already pointed out on p. 222 the very much greater incidence of sterility, miscarriages, still births, dead and diseased children in female tabetics and paralytics than occurs when the male is affected by these diseases. My inquiries regarding the results of conceptions in syphilitic parents illustrate the following points. The usual history is either complete sterility, or miscarriages, abortions, still births, children dying in infancy of convulsions, marasmus, meningitis, or hydrocephalus; then follow children who are *apparently* healthy but who subsequently in later life develop juvenile general paralysis, optic atrophy, tabes, nerve deafness, epilepsy, chorea, hysteria, and meningitis; but as the virus becomes attenuated the conceptions may result eventually, according to the law of gradual diminution in virulence of the syphilitic poison, in healthy children who in later life manifest no visible signs or symptoms of disease.

But many examples have occurred showing that the birth of healthy children is as Fournier says no ‘ free pass ’ for the escape of future offspring, and the following cases illustrate this fact :—

Case 51. N.O., Girl, aged 14. Juvenile general paralysis, with signs of congenital syphilis. History: No insanity, direct or collateral. Father died of an accident, aged 46. History from mother: Mother was married at 20, father at 22. There were twelve children as follows: (1) dead, 5 months foetus; (2) dead, 5 or 6 months foetus; (3) dead, 6 or 7 months foetus; (4) dead, 7 months foetus, lived eight hours; (5) born alive, very frail and delicate, ulcers on legs, inflammation of eyes; (6) patient; (7) girl, living well, aged 16; (8) boy, living well, aged 14; (9) boy, living well, aged 12; (10) boy, died of *convulsions*, aged 11 months; (11) girl, died at 8 months of *brain disease* and *club foot*; (12) boy, living well. The patient was an intelligent girl and passed the Seventh Standard at 12 years old; developed signs of general paralysis and progressive dementia at 14 and died three years later of this disease (Fig. 54). It will be seen that 7, 8, 9 are living and well, then follow two children with nervous affections and death.

Case 52. F. C., aged 11. Suffering with blindness since he was 7 years old. Snuffles at birth. The doctor, after marriage, treated the mother for acquired syphilis. No family history of nervous disorder or insanity. Three years elapsed before a 7 months still birth occurred, then (1) a girl was born that died with fits at 1 year and 9 months; (2) a girl, quite healthy, living; (3) a girl, quite healthy, living; (4) the patient; (5) boy, with paralysis, aged 9; (6) boy who suffers with fits. The patient when brought to me at Charing Cross Hospital exhibited no external signs of syphilis on the body and no evidence of visceral disease. There was slight evidence of old facial paresis of right side and the tongue on protrusion deviated to the right. There was optic atrophy in both eyes, also cycloplegia and iridoplegia. The fifth was a boy, aged 9, and I found him to be suffering with left facial nerve paralysis; the paralysis came on when he was aged 6 months. The eye could not be closed, nor the forehead wrinkled, the mouth was drawn to the right but not markedly. There was no deafness; he could hear a watch equally well in either ear and at a normal distance. This is against its being due to a syphilitic affection of the nerve. The sight was now becoming defective in the left eye, the disk being pale with a sharp edge; and probably he will become blind like his brother. In this

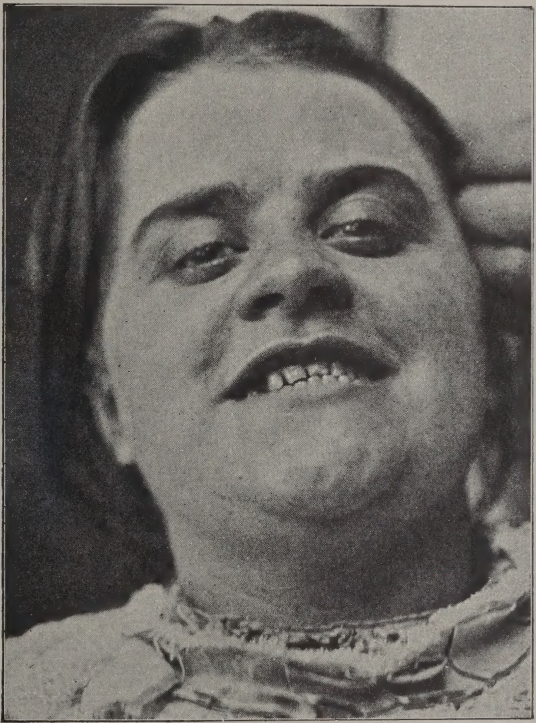

FIG. 54. Juvenile paralytic, showing the notched central incisors. The features have become coarse and there is a somewhat elated expression. Case 51.

history we find two healthy children preceding three children affected with severe nervous affections.

As a contrast to the above two cases I may mention the following case: CASE 53. R. D., a carpet planner who suffered with tabes, gave the following history of conceptions following his marriage at 22, which was just two years after he had contracted syphilis with a hard chancre, for which he was treated with mercury for only two months. The first child was born within one year of marriage and is alive and well, he has had six healthy living children, one of whom died aged 9; there were also twins born prematurely at six months.

Hochsinger throws doubt upon a healthy child slipping in between diseased children; of course we never really know whether a child of syphilitic parents is free from taint, for we are unable to see the state of his internal organs, and case 52, mentioned on p. 420 illustrates this fact most conclusively. Max Nonne, however, believes this is possible and states that within the last few years a large amount of material precisely controlled and obtained from the Engel Reimer division of the Hamburg Hospital (St. Georg) has shown that not infrequently a healthy child may slip in between two unhealthy ones. I have met with numerous cases in which the mother has had a series of healthy children, followed by miscarriages, still births, and children dying in infancy followed by syphilitic and parasyphilitic children. These cases often show the necessity of a systematic inquiry of the results of every conception, for the following case of juvenile general paralysis and optic atrophy was shown to me as a case in which syphilis could be excluded as there was a large healthy family and no history of syphilis of the parents; yet a systematic inquiry showed clearly that the reverse was the case and in spite of the denial of the father that he had suffered with venereal infection and of the mother that she had ever suffered with any signs or symptoms which could be associated with the disease, the history clearly points to maternal infection after she had had a family :—

CASE 54. A. B. was a bright intelligent girl who passed the Sixth Standard of the Board School and gained several prizes. She left school at 13; her periods never came on and this was the assigned cause of her complaint in the notes received from the infirmary where she was diagnosed as an imbecile, due to congenital brain disease. I took the following notes on the case: She is now aged over 15; she is completely blind in both eyes, she is quite childish but will talk and answer questions, but in the manner of a little girl of 6 or 7. She has no delusions or hallucinations, is obedient and now takes her food, although on admission to the asylum she was noisy, crying and troublesome. She was sent as an epileptic, but she has had no fits while in the asylum. Apparently, from what the mother tells me, she had several fits (like fainting attacks) while in the infirmary. She sits in a chair all day, the legs are rigid and semiflexed, the knee-jerks are not obtainable. She continually fidgets with her hands. I observe only slight tremor of the lips and tongue. The pupils are of medium size and do not react to light. There is primary optic atrophy on both sides. She has never complained of headache and there has been no vomiting. She does not respond to the calls of nature and passes urine and faeces unheeded. She recognizes her friends when they come to see her and talks to them affectionately. Her palate is high and narrow, the teeth show no signs of congenital syphilis, nor were there any stigmata on the body observed by the medical officer on examination. Syphilis was not therefore suspected. I interviewed the father and mother. Both said there was no insanity or nervous disease on either side. The mother informed me that she had had fourteen pregnancies. The patient was the next to the youngest living child. Prior to the birth of the patient she had had eight children, all of whom are now alive and grown up and some were married; then she had *two miscarriages followed by twins born dead*, followed by the patient, who had snuffles and a rash on the bottom soon after birth, for which she took her to St. George's Hospital where they gave her grey powders; she did not continue the treatment long. The dementia and paralysis are progressing.

Again, a long mercurial treatment of the father, although usually protecting the offspring from congenital syphilis, does not give a positively certain voucher of freedom from taint, as the following case shows: An intelligent professional man acquired syphilis and was treated by eminent authorities with mercury for several years; four years after the primary sore he consulted an eminent specialist as to the advisability of marriage; he was assured that there was no danger to his wife or offspring, he waited a year and married, with the following results: the first two children were born alive but died within a day or two of birth; the third developed keratitis and otitis with deafness; this child was seen by specialists, who pronounced the affection to be syphilitic; the fourth developed general paralysis and died (vide a valuable paper by Dr. Rondoni) with characteristic lesions at one of the London Asylums; the last two are now bright and healthy children.

Sir Jonathan Hutchinson asserts that 'a large experience on this point has led to the conclusion that a man rarely becomes the father of a syphilitic child if an interval of two years has elapsed since his disease was acquired'. Now we have reason to believe that the specific cause of infection is a living organism and that the testis is not an unusual location for it; moreover, the living organism may remain latent for a long time, consequently the sperm may be infected long after the primary infection and this may explain the case referred to; likewise if the ovaries are infected it may explain the fact that although the law of gradual diminution of virulence and risk of transmission holds good, yet exceptions may occur, as the following remarkable case reported by Molénes shows: 'A woman, aged 44, was married at the age of 21 to her first husband, by whom after the birth of a still living child she was infected by syphilis. Energetic mercury and iodide treatment of husband and wife followed. In the course of the following years she had six children who all died at ages of from 18 to 20 months with symptoms of meningitis. Six years after the death of the husband she married a healthy widower, father of two healthy children aged respectively 16 and 19. She now manifested a recurring syphilitic psoriasis for which she received courses of treatment. Twenty-two years after the primary infection and by her healthy husband she gave birth to a child. This child died just as the former ones died at the age of 18 months with symptoms of meningitis (vomiting, convulsions, coma).' Quoted from Max Nonne.

We may ask the question: Do recent researches and especially the discovery of the *Spirochaete pallida* and the inoculation of animals enable us better to understand the cause of congenital syphilitic disease, and especially the relation of the disease of the parents to imbecility, idiocy, epilepsy, and parasyphilitic affection of the offspring? Also, are we better able to understand and explain some of the anomalous cases of which I have given examples? If it be admitted that the *Spirochaete pallida* always remains a spiral organism and never undergoes any intracellular modification, then it becomes very difficult to explain spermatic infection of the ovum, for there is no possibility of the spirochaete being contained in the head of the *fertilizing* spermatozoon; it might, however, be supposed that the spirochaete gains entrance to the ovum during fertilization or subsequently. The researches of Leishman on the spirochaete of tick fever suggest the possibility of an intracellular phase of the spiral organism and its existence in the form of infective chromidian granules. Moreover, in support of this hypothesis, I may mention that Neisser in his experimental investigations on apes has observed that the tissues of infected animals, in which no spirochaetes were demonstrable, could nevertheless be used effectually for inoculation. The spirochaete may be one form of the syphilitic organism but there may be other minuter stages analogous to the spores of bacilli. These chromidian granules are contained in the *Spirochaete pallida*, and in all probability serve a similar function to the nucleus in more highly developed unicellular organisms; sometimes these chromidian granules can be seen in enormous numbers in tissues where the spirochaetes are found (vide photomicrograph, Plate I). As already mentioned (p. 419), the spirochaete has been seen by several observers in the ovum and it is improbable that such an infected ovum, even if it were capable of fertilization and segmentation, would undergo development to an embryo.

Consequently, where the mother escapes infection by the parasitic organism and the offspring alone is infected by it, there are two possible explanations :—

(1) The head of the spermatozoon is infected by a hypothetical syphilitic chromidian granule which *may* subsequently multiply and produce the syphilitic lesions.

(2) That if the specific organism never undergoes any modification or metamorphosis and only multiplies by longitudinal or transverse fission, the explanation of infection would be that spirochaetes contained in the sperm may remain alive in the uterus and gain ingress to the developing embryo without infecting the maternal uterus.

That the semen may contain the syphilitic contagion has been proved experimentally, for Neisser and Finger have shown that the testicles of syphilitic monkeys can be used to inoculate the chimpanzee, and Finger has successfully inoculated a chimpanzee with the semen of a man suffering from secondary syphilis.

In the investigation of the family histories of syphilitic parents, I have been struck with the relatively few cases of children who have survived after manifesting in infancy symptoms pointing to brain disease ; and this accords with other facts, viz. that although I have been able to collect sixty fatal cases of juvenile general paralysis and tabo-paralysis, I have only met with four fatal cases of coarse syphilitic brain disease due to congenital syphilis. Moreover, when I was searching for juvenile general paralytics I visited Darenth Asylum for Idiots, and I was much surprised at the relatively few cases Dr. Taylor, the superintendent, could show me of imbeciles or idiot children who presented obvious and obtrusive evidence of congenital syphilis. There were not more than could be counted on the fingers. It is probable, however, that ophthalmoscopic examination would have detected some cases of primary optic atrophy and some cases of choroido-retinitis ; moreover, a careful inquiry of the mothers regarding the ultimate result of conceptions would (as I have found in quite one-half the cases of juvenile general paralysis) have revealed the fact that congenital syphilis may have been a cause of congenital amentia in a certain number of cases in which there are no obtrusive stigmata. Still I came to the general conclusion that only a small percentage of the cases of idiocy and imbecility at Darenth could be associated with congenital syphilis.

In the London County Asylums I have met with a few fatal cases of congenital hemiplegia, epilepsy, and epilepsy with imbecility due to syphilitic endarteritis and softening. I have also met with one case of endarteritis and gummatous meningitis in a congenital syphilitic girl (vide pp. 437, 438), but relatively to juvenile general paralytics and tabo-paralytics with optic atrophy these cases are very rare. Moreover, I have looked through the 'Revue Neurologique' since its commencement seventeen years ago and I do not find more than a dozen cases recorded. Max Nonne cites only a few cases.

Still 'System of Syphilis' (vol. i, p. 328) states that he has seen very few cases and that they are rare as compared with juvenile general paralysis. The reason is doubtless due to the fact that if the syphilitic virus gains access to the cerebro-spinal cavity the offspring dies either before birth, at birth, or shortly after, or within a year or two; the causes of death being given as convulsions, hydrocephalus, or meningitis.

The classical works of Fournier, Hochsinger, Barlow, and others, have long demonstrated that many serious organic nervous diseases of children are the result of congenital syphilis, and Jullien was able to demonstrate that among 162 living children the progeny of forty-three syphilitic parents (in 206 pregnancies) 50 per cent. were affected with meningitis and convulsive symptoms. Although in my experience these conditions are common in congenital syphilitic infants, few of those so affected survived till puberty or adolescence; it is probable that when the central nervous system is invaded by the organism there is a general *Spirochaete septicaemia* which even the administration of mercury is unable to overcome sufficiently to prevent a fatal termination. The researches of Gasne before the discovery of Schaudinn and the remarkably interesting investigations of Ranke throw a light on this subject. Before, however, attending to these facts I will call attention to the observations of Heubner as to the frequency of affection of structures and organs in congenital syphilis; according to this eminent authority the structures are affected in the following order: liver, lungs, spleen, alimentary canal, heart and blood-vessels, and lastly the nervous system. Rumpf gives the relative frequency of affection of the nervous system as 13 per cent.

Gasne studied the spinal cords of thirty foetuses of which twenty-six were born of syphilitic parents; in four cases he found profound lesions identical to those observed in acquired syphilis and in seven cases there were doubtful changes. He also observed that the lesions were predominant in the posterior region of the spinal cord.

Ranke in a very valuable investigation has studied the brain changes in congenital syphilis. He has made observations upon sixty brains of foetuses and infants with a view of determining whether in cases of tabes and general paralysis due to congenital syphilis the changes in the central nervous system agree with the lesion of the brain of congenital syphilitic children, or whether the lesions should be attributed to damage of the germ plasm during development. He first points out that it was necessary to ascertain if the *Spirochaete pallida* be present in the brains of congenital syphilitic foetuses and newborn infants, and if this be the case whether it can be concluded that the lesions are directly due to its presence. All the organs of the body may show characteristic lesions in congenital syphilis; they may be found in the specific skin lesions, especially the bullae of pemphigus, the lymphatic glands, the pancreas, liver, spleen, kidneys, lungs (white pneumonia), the bones, and the vascular system. There are two forms of morbid change in these organs and tissues, viz. exudative and inflammatory, with which also must be associated gummatous neoplasms in the organs of syphilitic children. Besides these changes there is a cell proliferation independent of the vascular distribution and which has been described as occurring especially in the liver and kidneys. In addition to this evidence of proliferative changes Stroebe and particularly Karvonen have described a progressive arrest of development in the kidney as shown by a diminution of the normal glomeruli and in the presence at the time of birth of pseudo-glomeruli; also there is an appearance of necrogenous tracts of tissue in the parenchyma of the kidney which these observers regard as especially characteristic of congenital syphilis. Ranke remarks that none of the standard textbooks on children's diseases deal efficiently with the subject of congenital syphilis and the nervous system, and no mention is made of changes in the central nervous system by Rudolf Hecker in his excellent *Beiträge zur Histologie und Pathologie der Cong. Syphilis*, 1898.

The cerebral gumma generally associated with progressive meningitis and meningo-encephalitis has been most frequently described, but not infrequently this is associated with disease of the larger cerebral vessels which was first found in the brain of a syphilitic child. These cases of syphilis of the nervous system will be described at greater length later when the symptoms of infantile syphilis of the nervous system are considered.

But in addition to these reported cases of specific affection of the nervous tissues in congenital syphilis which are indistinguishable in their naked-eye and microscopic characters from similar affections of the adult due to acquired syphilis, a few cases have been reported of arrest of development; especially interesting in this respect is a case of Ilberg's in which a child 6 days old, the subject of congenital syphilis, was found at the post-mortem examination to possess a brain exhibiting a remarkable arrest of development of the centrum ovale, the corpus callosum and other commissures, as well as of the pyramidal systems of fibres. There was also asymmetry of the two halves of the cerebellum and arrest of development of the optic nerve-fibres. Sibelius has reported changes of a more delicate character; he found in his researches upon the central nervous system of congenital syphilitics, groups or colonies of spinal ganglion cells exhibiting delayed or abnormal development. In very severe cases of congenital syphilis he was able to demonstrate such colonies of abnormal cells amid typical ganglion cells in abundance and relatively often. He considers these morbid evidences of delay and arrest of development to be occasioned by the syphilitic toxin.

This leads me to consider a very important question, viz. Does the poison cause various grades of idiocy, imbecility, and epilepsy? In fact, what is the evidence in favour of congenital syphilis being the cause of arrest of development of the brain apart from its causing gross syphilitic lesions either by the influence of a chemical toxin or some failure of a biochemical substance necessary for the development of the brain tissues? This question is one of the greatest practical, and even national importance; the anatomical evidence rests upon far too meagre reports, and the biochemical changes, which we now know occur in the blood and tissues as a result of the invasion of the organism of syphilis, are not yet sufficiently understood to allow of more than hypothetical speculation as to the influence they might have upon the development of the nerve cells; consequently we must fall back upon statistical and clinical evidence, a not altogether satisfactory source of knowledge, for the reason that the personal equation of the inquirer is so frequently biassed and prejudiced that an overestimate of syphilis as a cause or an underestimate is arrived at, according to the preconceived notion of the investigator.

Some of the German statistics are given by Ranke as follows: Binswanger, whose statistics have been based upon a large number of idiots, gives 9·5 per cent. as certain, and 12·2 per cent. probable syphilis of one of the parents. Similar results were obtained by Wildermuth. Ziehen gives 10 per cent. demonstrable and a further 17 per cent. probable. On the other hand Bourneville holds that congenital syphilis is an exceedingly rare cause of idiocy. Langdon Down found it in only 2 per cent. of cases and Shuttleworth, among 1,000 idiots at Darenth, only found 1 per cent. of congenital syphilis. Telford Smith found only eight cases with marked evidence of congenital syphilis amongst 580 inmates of the Royal Albert Asylum. Similarly, Brown in America only found 1–1·5 per cent. of syphilitic origin. Seeing how very prevalent syphilis is among the population, it is impossible to judge how far syphilis on the father's side should be considered as cause or coincidence. On the other hand we should be considerably under the mark if all cases of arrested development of the brain were omitted that did not exhibit obtrusive stigmata of congenital syphilis, e.g. Hutchinson's teeth, old keratitis, rhagades at the angles of the mouth, nerve-deafness, epiphysitis, onychia, &c.

There can be no doubt that syphilis in the parents may lead to infantilism in the offspring, and I have seen numerous cases of such in which there were none of the above-mentioned obtrusive signs of syphilis and yet other children of the same parents presented well-marked obtrusive stigmata; moreover, cases show that one individual of a family of congenital syphilitics may exhibit the characteristic stigmata of congenital syphilis and another show no external signs, yet the internal organs may exhibit post mortem the most marked evidences of the disease. If syphilis can produce bodily infantilism including arrest of development of the reproductive organs, a frequent condition in juvenile general paralysis, surely there is no reason why it should not lead to arrest of development of the most highly differentiated and specialized tissues of the body, e.g. the cerebral cortex.

Although the microscopic and statistical evidence in favour of syphilis being an important cause of arrest of development of the neurone, especially of the cortex cerebri, is by no means strong, it must be remembered that only a small proportion of the children of syphilitic parents present definite observable stigmata of congenital syphilis. It is quite probable, therefore, that syphilis plays a more important part in the production of imbecility and idiocy than is apparent from the English statistics which have been quoted. The influence of syphilis is not infrequently combined with chronic alcoholism, and the latter among the poorer classes being a more easily ascertainable cause by those preparing statistics, is assigned as the cause in the parents of the mental deficiency in their offspring. Both poisons co-operate in devitalizing the tissues of the body, and there is no reason to suppose that the germ cells escape from this devitalizing influence. Koenig, in a valuable and interesting paper on 'The Problem of Heredity from the Psychiatrical Aspect', gave as his experience that 'the offspring of paralytic parents are often imbeciles, idiots, victims of infantile cerebral paralysis, sufferers from early epilepsy, chorea, meningitis, congenital syphilis, and various other neurotic ailments. There would be a considerably larger number of these youthful invalids but for the high rate of sterility, miscarriages, still-born, and short-lived offspring. I have recorded 150 absolutely sterile marriages not including those of a more or less long train of abortions. Among the adult descendants I have noted a fair number of paranoiacs, cases belonging to the *Dementia praecox* group and other types of organic and functional disorder. On the other hand a not infrequent record of exclusively sound children could be obtained. In quite a number of these homologous cases both ascendants and descendants had a clear history of syphilis.' With this statement my experience entirely accords. Koenig, moreover, asserts that too much insistence cannot be laid upon syphilis being the necessary step in the production of general paralysis. Alcoholism and environment are contributory factors, but a much greater allowance, however, has to be made for the force of hereditary predisposition, all the more so when we realize the preponderance of syphilitic victims who never develop general paralysis nor any nervous complaint.

I have already given reasons for supposing that only in a community which has acquired immunity by widespread syphilization through several generations do we find general paralysis ; it is a true type of acquired mental derangement.

Beard, in the discussion on heredity when Koenig read his paper, said: 'It is a known fact that toxins weaken cells and therefore germ cells ; a germ cell as an adult living organism with a life cycle must, like all living cells, feed, grow, reproduce, and exhibit irritability.' Consequently, we may presume that there is reason for supposing that the two most potent and prevalent poisons, alcohol and syphilis, may without killing the germ cells diminish their *vita propria*, and thus lead to the various disordered and diseased conditions of the nervous system.

Nevertheless, experience shows that imbecility and idiocy are more frequently met with in rural populations than urban ; it is a fact even in communities, where purity of living and sobriety are the rule, that imbecility, idiocy, and certain forms of insanity are almost as common as among the general population. Again, in the rural districts of Ireland syphilis is comparatively infrequent, general paralysis is hardly ever seen, yet the relative percentage to the population of imbecility, idiocy, and insanity, is very high. Doubtless this fact, as well as the fact that a greater proportion of cases of congenital amentia *pro rata* occur among the inmates of rural than urban asylums, may be accounted for thus: there has been a constant drain of emigration of the mentally and physically fit to industrial centres leaving the unfit to procreate their species.

In the large number of cases of juvenile general paralysis which have come under my notice, quite one half have been congenital imbeciles who at puberty or later developed general paralysis. I have not been able to associate the congenital imbecility with a marked mental deficiency in the parents, although I should say in quite 20 per cent. of the cases I ascertained that the father had died in an asylum of general paralysis. The subjects of congenital imbecility bore on their bodies well-marked stigmata of congenital syphilis or exhibited signs of bone or visceral syphilis at the post-mortem examination considerably more often than those who up to puberty were bright and intelligent. The examination of the brains of these congenital imbeciles showed no signs of endarteritis or gross changes to account for the failure of development of the brain. Moreover, the majority of these congenital imbeciles were stunted in growth and their reproductive organs and genitals were infantile. Examination of the ovaries showed great deficiency of ova in numbers and development. The testicles generally were very small and showed no spermatozoa. Moreover, besides the more or less recent degenerative changes in the cortical pyramidal cells, there were many indications of arrest of development; in one case I found calcification of the pyramidal cells, a condition I have never seen in general paralysis of the adult, no matter how prolonged the disease has been. I cannot but think, therefore, there is evidence to show that the syphilitic virus may devitalize the germ cells and play an important rôle in the arrest of development of the functionally more complex neurones of the brain, also to a metabolic biochemical functional instability of neurones whereby neuroses and psychoses may be engendered. These morbid conditions not being due to the direct action of the specific organism upon the brain itself, but by virtue of biochemical changes in the developing embryo; changes, indeed, which may lead to its subsequent immunity, complete or partial, to the action of the specific organism.

THE EXISTENCE OF SPIROCHAETES IN THE NERVOUS SYSTEM

Drs. Ravaut and Ponselle found spirochaetes in great numbers in the vessel walls, in the lumen of the vessels and inflamed pial tissues of a 5 weeks old infant the subject of congenital syphilis suffering with extensive meningo-myelitis; and Ranke has shown in nine out of twelve cases of congenital syphilis, in which the offspring died before birth or within a short time after birth, abundance of spirochaetes in the inflamed pia-arachnoid membranes, in the walls of the vessels, especially the veins, and in the lumen of the vessels; this was associated with characteristic cellular changes, viz. lymphocyte and plasma cell infiltrations, endothelial proliferation, and glia cell hyperplasia. This condition is indicative of a general *Spirochaete septicaemia* and is inconsistent with life; likewise if an invasion of the cerebro-spinal axis takes place during infancy it is highly improbable that the child will survive, and death takes place from various typical syphilitic brain affections; but inasmuch as only 3 per cent. or 4 per cent. of adults with acquired syphilis suffer from affections of the central nervous system, the number of cases dying in early infancy from congenital syphilis of the nervous system is proportionally very high, notwithstanding the fact that there are not very many reported cases with post-mortem examination. Ravaut has contributed an important work based upon the prolonged observation of twenty-eight little heredo-syphilitics. The cerebro-spinal fluid was examined in cases every time nervous symptoms were manifested and lymphocytosis was found. He points out that lymphocytosis may thus be used as a guide for diagnosis when manifest signs of congenital syphilis are not present, and that suitable antisyphilitic treatment should be adopted and not suspended until the symptoms subside and the lymphocytes have disappeared.

HYDROCEPHALUS

Mendel was one of the earliest writers concerning hereditary syphilis in respect to its action in the production of mental diseases.

He refers to the fact that Carl Haase in the year 1828 related the case of a young woman who was infected by her husband at the age of 22; in consequence she had three premature still-born children; a fourth was born at full term living but died at the age of 7 months of hydrocephalus. He also mentions that Von Rosen in 1862 published several cases in which hereditary syphilitic children died of hydrocephalus in early infancy; moreover, Engelberg, Howitz, Cruveilhier, and V. Bärensprung described cases, and Howitz ascribed to pachymeningitis and leptomeningitis a fatal hydrocephalus in a congenital syphilitic child. Similar cases were recorded by Virchow, V. Bärensprung, and Mendel himself.

Congenital malformations as well as hydrocephalus may arise from vascular disease in early uterine life. Elsner has described interstitial inflammation of a specific character affecting the choroid plexus. Still (‘System of Syphilis,’ vol. i, p. 327) states that amongst 30 cases of hydrocephalus under his observation only 2 were certainly syphilitic. The late Dr. Ashby recorded a case in which hydrocephalus began in a syphilitic infant at the age of 3 months, and he mentions a case of Heller’s in which hydrocephalus came on between the fourth and seventh months. Four cases have been recorded by Sandoz, in which hydrocephalus was present at nine weeks, at six weeks, a few days after birth, and about fourteen days after birth; the first three were examined post mortem and a thickening and roughening of the ependyma of the lateral ventricles was discovered; moreover, the choroid plexus had an oedematous appearance and was gorged with blood.

Hochsinger has studied 362 cases of heredo-syphilis; of these

34 were hydrocephalic; in the majority of cases it began within three to eleven months of birth and it was present six times in foetal life; nervous symptoms were absent in 11 cases, but in others the symptoms were restlessness, sleeplessness, chronic vomiting, contractures and convulsions, increase of tendon reflexes, nystagmus, and idiocy. It may, therefore, in rare cases closely simulate tubercular meningitis in its symptomatology; in some cases the beneficial effects of treatment have proved its syphilitic nature; moreover, the Wassermann test might prove most useful in diagnosis. Miliary gummata of the ependyma of the lateral ventricles have been described by Virchow and Jürgens in cases of syphilitic hydrocephalus. Hydrocephalus is usually met with in early life and generally proves fatal when the symptoms are obvious, but Oppenheim mentions that he once saw a case of well-marked hydrocephalus which first developed obvious symptoms at puberty and subsequently very severe phenomena developed. It is manifest that hydrocephalus is the result of an accumulation of cerebro-spinal fluid in the lateral ventricles; all syphilitic conditions therefore which prevent the escape of the fluid from the lateral ventricles, where it is mainly secreted by the choroid plexus, will occasion its accumulation. Dr. Still suggests that congenital malformation might cause blocking of the *iter a tertio*, but seeing that Ranke has shown that true syphilitic specific inflammations of the membranes and encephalitic foci are common in congenital syphilis, it is more easy to explain the hydrocephalus by the effect of these lesions interfering with the outflow of cerebro-spinal fluid. I have already stated that all forms of syphilitic brain disease occurring in the adult as a result of acquired syphilis may be met with in childhood or even later life as a result of congenital syphilis; thus there may be local and general true syphilitic inflammatory affections of the membranes and vessels with the formation of gummatous tumours causing secondary changes in the nervous structures, or there may be primary degenerative conditions (parasyphilis).

ARTERITIS, MENINGITIS, AND GUMMATA

Endarteritis syphilitica has been described by Chiari in an infant aged 15 months, and a number of other authorities have recorded cases in which congenital syphilitic endo- meso- and peri-arteritis have been the only lesions, or, as in the majority of cases, only a part of manifold syphilitic processes affecting the mesodermic structures, especially pachymeningitis, gummatous processes, and diffuse sclerosis.

True syphilitic diseases of the nervous system in congenital syphilis are nearly always combined, thus we find a generalized leptomeningitis and pachymeningitis, small and large gummata, gummatous neuritis and endarteritis associated in varying degrees. A certain number of such cases have been recorded, e. g. Sir T. Barlow recorded the case of a male infant aged 15 months who had weakness of the facial muscles and nystagmus; at the post-mortem examination small conical tumours were found in the fourth, fifth, sixth, seventh, and eighth nerves, at their point of exit from the brain stem; these appeared to be of a gummatous nature; there was an associated endarteritis, the basilar and all the vessels of the circle of Willis were extensively diseased; these were opaque, dirty-white in colour, and almost cartilaginous in consistence; the lumen was greatly narrowed by thickening of the interior, and the small arterioles of the *pia mater* were similarly affected. Bury, Money, Jürgens, and many others have published similar cases.

The following case of heredo-syphilis tarda, which I have published in full in vol. iv, *Archives of Neurology and Psychiatry*, is of interest, for such cases are extremely rare.

Case 55. E. M. A., female, aged 16, admitted to Claybury Asylum, August 30, 1905, died July 8, 1906. Her mother had three miscarriages, then five children born alive, of which she was the last. She was delicate from birth; she had snuffles and coryza, and was treated with grey powder; she was undersized, looking about 11 years of age, and had well-marked Hutchinsonian teeth; she must have been fairly intelligent, as she was in the Sixth Standard at the Board School. On admission she was thought to be a congenital imbecile suffering from mania. For three months before death she had stiffness and rigidity of the neck; she became drowsy and helpless and there was an internal strabismus of the right eye. At the autopsy a generalized cerebro-spinal gummatous meningitis and universal perivascularitis and endarteritis were found; all the arteries of the circle of Willis showed a profound periarteritis and obliterative endarteritis; the perivascular and neoplastic infiltration was universal; it corresponded entirely in its histological characters with a gummatous meningo-encephalitis; at the upper part of the spinal cord the roots were surrounded by an infiltrating exudation quite 3 mm. in thickness. The neoplastic formation consisted of proliferated, branched, and spindle-shaped, connective tissue cells, and round or oval cells forming all stages between lymphocytes and plasma cells; there were also macrophages, but polymorphnuclears were conspicuous by their absence; large numbers of the cells were undergoing a granulo-aqueous degeneration; considering the universal vascular change and perivascular infiltration affecting the vessels of the brain and spinal cord including the roots, it was astonishing how little had been the destruction of nerve cells and fibres.

Another case of heredo-syphilis tarda which occurred at Claybury has been investigated by Dr. Rondoni and recently published in the *Proceedings of the Royal Society of Medicine.*

CASE 56. The patient, a girl, was healthy until aged 14; she afterwards became dull and apathetic, suffered with fits (apoplectic), coarse tremor of arms, nystagmus, exaggeration of knee-jerks, and inequality of the pupils. The family history obtained was two miscarriages; one boy who lived only seven months, a boy who lived fifteen months; then the patient who died at the age of 23; then came a healthy living girl and lastly a girl who lived only sixteen months. Rondoni found an old diffuse endarteritis syphilitica with numerous small aneurysmal dilatations, especially of the arteries of the basal ganglia. The arteritis was evidently of long standing, for many of the small vessels in the basal ganglia showed calcareous infiltration and patches of old softening which can be correlated with the apoplectic fits. The small veins are also affected. Rondoni considers this to be a case of *syphilis hereditaria tarda* of the nervous system similar to the cases of Homen and La Chapelle. The cases of Homen differ only because they were familial (five brothers and sisters). In Homen's cases there were diffuse degenerative changes in the cortical cells without granulation in the ependyma, arterial lesions and softenings in the basal ganglia, little proliferation of glia and only a slight perivascular infiltration. The general character of Homen's cases was as follows : at the ages of 20, 12, and 20, the disease manifested itself by phenomena of vertigo, headache, disturbances of general well-being, diminished intelligence and weakness of memory, diffuse vague pains in the legs, oscillating gait and difficulty of speech ; the intellectual loss proceeded to an actual dementia ; the speech disturbance was rather inability to initiate than to articulate. Spastic conditions in the legs came on, also in the arms ; in both situations it progressed to actual contractures. Pupil phenomena and anaesthesia were absent. In all three sisters a certain degree of infantilism occurred.

In both the cases I have related the patients showed a marked degree of infantilism of the generative organs. In view of the results obtained by Kretschner, who has shown that *syphilis hereditaria tarda* is associated with a lymphocytosis of the cerebro-spinal fluid, it would have been interesting if lumbar puncture had been performed in these cases.

Cases have been recorded of syphilitic disease of the brain, the spinal cord, their cavities and vessels. Dowse, Siemerling, Bury, Böttiger and Pick. The nervous disease of the child began in the case reported by Dowse at the age of 10; Siemerling's at the age of 6 ; and Bury's at the age of 8. An especially large single gummatous tumour situated in the occipital lobe which had led to erosion of the cranium has been recorded by Hutchinson in a girl of 16. Hutchinson looked upon the case as one of *syphilis hereditaria tarda.*

I have remarked on p. 110 that most cases of so-called syphilitic meningitis or meningo-myelitis are in reality not localised to the spinal cord, but affect also the base of the brain and its stem ; they are really cases of cerebro-spinal meningitis in which the cerebral symptoms are slight and the spinal symptoms obtrusive; consequently it is not surprising that there are no recorded cases, so far as I can find, of congenital spinal syphilis, although in all cases of diffuse meningitis and arteritis the spinal structures participate in the form of disease of arteries and veins, of circumscribed and diffuse infiltrating gummatous neoplasms, meningitis and neuritis affecting the anterior, and especially the posterior spinal roots. In fact all the evidence tends to prove that in congenital syphilitic disease of the nervous system, multiple combined affections are the rule, and it seems probable that tissues which are undergoing development afford a more congenial soil for the specific organism to grow and multiply in; consequently infection of the central nervous system is especially liable to lead to severe disturbances and loss of function and early death when it is not immediately fatal. Moreover, although other etiological factors, e.g. alcoholism and mental stress, do not directly play a part, yet it is highly probable that alcoholism and particularly a neuropathic or psychopathic taint in progenitors play an important part as contributory factors in the later development of general paralysis, optic atrophy and tabes, also epilepsy, hysteria, and other neuroses of congenital syphilitic children (vide p. 187).

EPILEPSY

I have seen a few cases of epilepsy in my hospital practice which I could associate with congenital syphilis, and I think if a routine ophthalmoscopic examination were made, choroido-retinitis might be found in a number of cases of epilepsy in asylums; unless an examination for all the less obvious stigmata of congenital syphilis be made, and also a careful inquiry into the family history of every case, statistics relating to congenital syphilis as a cause of epilepsy are as useless and unreliable as they are to the relationship of congenital syphilis to imbecility and idiocy. In the absence of any precise data a general conclusion can often be arrived at that is sometimes more valuable than statistics of a sort.

I have seen cases of epilepsy during life and post mortem which I have had no hesitation in associating with brain lesions produced by congenital syphilis (vide Fig. 55). Thus an epileptic feeble-minded hemiplegic woman told me that she had been paralysed in her right side from early infancy; examination of the eyes showed a well-marked choroido-retinitis, she had signs of old interstitial keratitis in one eye and a squint which she suffered with in early life; later on she developed epileptic fits. I have seen many cases of syphilitic brain disease in adult life followed by softening near the motor area act as a source of irritation, at first causing Jacksonian epilepsy, but the convulsions after a time became so generalized that they were indistinguishable from ordinary symptomatic epilepsy; such cases are not uncommon in asylums. These patients suffering with epilepsy due to organic syphilitic lesions often have unequal pupils, and it might be thought they were general paralytics.

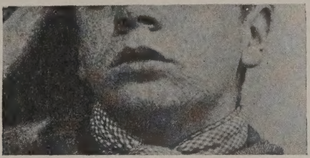

Fig. 55. Mouth of congenital syphilitic, showing marked rhagades. The patient suffered with epilepsy from childhood.

Congenital syphilis and symptomatic epilepsy are both fairly common diseases, consequently because there are stigmata of syphilis on the body of a juvenile epileptic it does not necessarily follow that there is a causal connexion between the epilepsy and the syphilis, unless it can be proved that the syphilis has so damaged the brain in some region near the motor area that the lesion can act as a source of irritation; that is to say it may be coincidence.

The question whether syphilis of the parents can modify the germ plasm so as to render it biochemically unstable, whereby a slight excitation suffices to produce a fit, like the spark in a powder magazine causes an explosion, is one that cannot be satisfactorily answered. Yet we should rather expect that such a poison could influence the germ plasm so unfavourably as to affect the proper development of its most complex and highly differentiated structural product—the cerebral cortex.

Fournier, Erlenmeyer, Heubner, Fischl, and many others have cited some very remarkable instances of congenital syphilitic children apparently spontaneously developing epilepsy. The statistics at hand are not very valuable; according to Veit (Wuhlgarten) the proportion of congenital syphilitics among the epileptics was 7 per cent. Binswanger asserts that congenital syphilis plays a much more important predisposing rôle in the production of epilepsy than is generally imagined. He speaks of a dyscrasic form of hereditary syphilitic epilepsy. I think it would be a legitimate conclusion to arrive at, that congenital syphilis was the cause of symptomatic epilepsy if the parents of the syphilitic child both came from sound stocks in which there was no previous epilepsy, migraine or insanity; e.g. a case under my care showed no family history to account for the onset of symptomatic epilepsy in early youth; there was no history of syphilis in father or mother, but ophthalmoscopic examination revealed a well-marked choroido-retinitis.

Without attempting to give any precise data I am of opinion that syphilis and alcoholism of the parents may influence the germ plasm and *per se* lead to the production of imbecility and symptomatic epilepsy; but seeing how very common the combination of syphilis and alcoholism is, the fact of a child of parents so affected suffering with epilepsy may be only coincidence. If, as in the case of juvenile general paralysis and optic atrophy, syphilis were an invariable antecedent in epilepsy, or even if it were a frequent antecedent, it might be conceded that the syphilitic poison was epileptogenous; but inasmuch as epilepsy occurs frequently in communities where syphilis is unknown, and among total abstainers almost as frequently as in drinkers, the causal relationship of syphilis and alcoholism in the parents with epilepsy in the offspring is uncertain. What certainly is true is that if there be a neuropathic or psychopathic taint in the progenitors, alcohol and syphilis will singly or combined tend to bring out that neuropathic taint—and were it not for the fact that both these poisons are *deadly* as well as devitalizing, the effects on humanity would be cumulative and lead to racial annihilation. Thus, after all, these two scourges of humanity may lead to the survival of the socially and morally fittest, by killing the progeny of those stocks which have an inherent lack of judgement and highest control; in this way counterbalancing to some extent the degeneracy which they produce and are directly responsible for. Venereal diseases are much the most potent factors in the production of sterility, miscarriages, abortions and infantile deaths; in fact it is questionable whether chronic alcoholism can operate *per se*. Chronic alcoholics are improvident and have numbers of children, but do not rear them. Venereal disease is so frequently associated with chronic alcoholism that the progeny of drunkards is greatly diminished in consequence of their much greater liability to contract these diseases.

ENCEPHALITIS

Syphilitic encephalitis has been given as a cause of spastic paraplegia (Little's disease) and of spastic hemiplegia; Oppenheim and Casirer in their valuable monograph on encephalitis, however, express the opinion that syphilis plays an unimportant part in the production of encephalitis. Max Nonne from his experience comes to a similar conclusion, and Sachs, who has had a very large experience regarding encephalitic paralysis of children, only found two cases of hereditary syphilis in 200 cases of congenital paralysis. Moreover, the post-mortem experience of Von Recklinghausen is to the effect that a true encephalitis is rare in hereditary syphilis. He found encephalitis only twice in 45 cases of hereditary syphilis occurring in the post-mortem examination of 1,600 children. Possibly, however, had a microscopic investigation been made as Ranke has done, the results might have been different. Fournier, Gilles de la Tourette, Charcot, Heubner, Franke and Erlenmeyer, on the contrary, consider congenital syphilis an important cause of Little's disease. My own experience would assign congenital syphilis a place inferior to asphyxial conditions at birth, head injury, and the infectious diseases of childhood; not that I disbelieve the important influence of congenital syphilis in its production of encephalitis, but its relative infrequency I would explain by the fact that if the living virus gains access to the cranio-spinal cavity, in the great majority of cases it proves fatal within a short time owing to spirillar septicaemia, as Ranks has shown; or the infant, if born alive, dies of hydrocephalus or meningitis within a short time after birth.

Symptomatology. Since congenital syphilis produces the same pathological changes in the central nervous system as acquired syphilis, the symptomatology is necessarily very much the same.

Convulsions. Barlow and Bury point out the frequency of early convulsions in congenital syphilitic children; some of their cases exhibited this symptom quite early. Their experience is thus summed up: 'The earliest case of convulsions with subsequent post-mortem verification of extensive meningeal changes was observed by one of us in a child of 4 months old, but we have notes of several at the age of 3 months, without post-mortem verification, and one of a syphilitic infant, who had ten or twelve fits daily from the age of 14 days to 7 months.' There is practically no period after birth up to two years in which convulsions may not occur. The fits are usually bilateral, consisting of tonic and clonic spasms; in some there is opisthotonos, spasms with persistent retraction of head and neck; and laryngismus stridulus not infrequently occurs. These authorities remark that it is important to note that syphilitic infants simultaneously or shortly after the appearance of the rash and snuffles may develop bilateral fits and laryngismus; months or years may then elapse without fresh symptoms, as if the virus were latent, and then a unilateral spasm or paralysis may ensue. The following example is given : T. H., snuffles at 4 weeks and probably pemphigus succeeded by bilateral fits, three or four a month up to 1 year. The child was unable to sit up till the age of 3, and did not walk till 4 years of age. At the age of 4 it had two right-sided fits within six months followed by right hemiplegia and dysarthria. She was seen again at 10 years of age and exhibited the usual well-marked stigmata of congenital syphilis. The right eye was blind and there was extensive detachment of the retina. The left showed atrophy of the disk and old choroiditis. There was some paresis of the right upper and lower limbs, but no spasm, and there was a slight arrest of development (as shown in length and circumference) in the right forearm as compared with the left. There was no evidence of paralysis of any cranial nerve. She heard and understood many things which were said to her, and answered some questions, but could not be trusted in her replies to questions in testing common sensation and special sense. There was a slight articulatory defect, as of a young child who had not long learned to talk. She was docile, but distinctly retarded in her intellectual development for a child nearly eleven. She died of nephritis, and at the post mortem her brain showed remarkable sclerosis of both hemispheres, the left being more affected than the right, with marked shrinkage in both transverse and longitudinal measurements. There was also extensive endo-arteritis of all the arteries of the circle of Willis and their branches.

Headache and irritability. I have alluded to the fact that headache worse at night is a sign of brain disease due to acquired syphilis, but according to Barlow and Bury it is also met with in brain disease due to congenital syphilis. Definite complaints of headache are not made by infants and young children, but these authorities state that their experience shows that syphilitic infants sleep badly; they have screaming fits and they have known cases of torpor, paresis and unilateral convulsions ushered in by excessive irritability and stiffness of the neck, either with the head retracted or held to one side.

'Demme records a case of a syphilitic child who had attacks of headache followed by outbursts of rage, then of stupidity followed by diabetes insipidus.'

Multiple Lesions

Multiple lesions are usually found in a case of paralysis due to congenital syphilis. Thus there may exist in the same case endarteritis, meningitis, and gummatous tumours, just as in the acquired form of the disease. The arterial disease may be followed by thrombosis and softening and very occasionally by haemorrhage.

Symptomatology. A frequent symptom of congenital syphilitic brain disease is hemiplegia; it is usually preceded by unilateral convulsions and the convulsions may occur at intervals again on the paretic side. In some cases there is an onset like an apoplectic fit, and without any warning the child may fall down unconscious and remain so for a varying period of time. In other cases the child may be irritable, restless, and if old enough it may be noticed that it has suffered from headache and attacks of vomiting; suddenly, or perhaps comparatively suddenly, and without loss of consciousness, there may be a loss of power on one side of the body and the speech may become thick and indistinct. Attacks of drowsy torpor and somnolence so characteristic of cerebral syphilis in the adult may also occur in the child.

Speech defects of the nature of dysarthria or aphasia frequently occur, but as a rule they are more temporary in cases of congenital syphilitic hemiplegia than when occurring in the adult; Barlow and Bury state that: 'in many of the initial attacks of hemiplegia paresis of the limbs, so far as its gross indications are concerned, clears up to a great extent and the paresis of the face to a marked extent. The only vestige may be that the child does not use the arm and hand which have been affected quite as freely as those of the opposite limb.' But as in the adult form, so in the congenital, there is a great proneness to subsequent attacks, after which a spastic condition may supervene; following an attack affecting one side of the body there is a marked liability to affection of the opposite side.

In the hemiplegic condition of children, speech affections are as a rule much more transient than in hemiplegias of adults. Some interesting cases are recorded by the above-mentioned authors. Any one or several of the cranial nerves may be affected apart from evidence of disease of the brain or definite meningitic symptoms; the nerve affection may be unilateral or both sides may be affected or several pairs of nerves; again, separate portions of the third and fifth nerves may be paralysed; occasionally, but rarely, the facial nerve is affected (vide Case 52, p. 420).

Sir Jonathan Hutchinson has recorded two cases of *ophthalmoplegia externa* in congenital syphilis.

Barlow and Bury from an analysis of 90 reported cases of brain disease due to congenital syphilis found nearly one-half (40) in which there was some mental failure or disturbance noticed, and in their opinion this underestimates rather than overstates the actual facts.

There is little to be added to Sir Jonathan Hutchinson's clinical account given thirty years ago of the deafness due to hereditary syphilis, it comes on mostly between the periods of five years before and five years after puberty; it is bilateral, painless, and unattended by otorrhoea. In many cases bone conduction is absent. I have met with two typical cases, but as compared with primary optic atrophy they are rare.

PARASYPHILITIC ORGANIC DISEASES DUE TO CONGENITAL SYPHILIS

Juvenile general paralysis and tabes. Prior to 1877 general paralysis of the insane was believed to be essentially a disease of adult life only. In that year Professor Clouston described a case of the disease in a boy, aged 16, and he pointed out that clinically and pathologically the disease that affected his patient in no way essentially differed from the adult form.

I have already dealt with the important facts concerning the etiology of these parasyphilitic affections in the chapter on parasyphilis (p. 186), but I may remark that the majority of the cases which are admitted to the asylums are diagnosed as epileptic imbeciles, yet careful inquiry from the parents of quite one-half of the cases shows that until puberty these children were up to the average standard in intelligence, for they usually attained the Sixth Standard in the Board School; others were feeble-minded and backward from birth, but only developed the signs of an active degeneration at puberty or occasionally earlier. My experience relates to 60 cases in the London County Asylums, and I will briefly refer to those facts which I consider are of greatest importance in regard to the symptomatology and course of the disease, a full account of which will be found in vol. i, *Archives of Neurology.* I need not refer again to the pathology, for that corresponds absolutely with the adult form of the disease already described on pp. 276–86. The excellent article by Dr. G. Watson, in vol. ii, *Archives of Neurology*, may be referred to with advantage for a full and detailed account of the microscopic changes in the brain, and as a supplement to this I have on p. 283 given the excellent account of the examination by Dr. Rondoni of two of my cases of juvenile general paralysis in which newer methods have been employed and some new facts elicited.

It is possible that juvenile paralysis might occur within a few years of birth, but the earliest case which came under my notice was a boy with well-marked stigmata of congenital syphilis (vide Fig. 56, p. 449) who attended my out-patient department at Charing Cross Hospital.

Case 57. F. J., at the age of 9, first came under my observation; he had typical Hutchinsonian teeth, keratitis, choroido-retinitis, internal strabismus, rhagades, and epiphysitis; the latter healed with mercurial treatment. After attending nearly a year his mother came and described several seizures which he had had at school. The pupils were unequal and reacted sluggishly to light. He had had a similar fit two years previously at the age of 8; consequently, as events subsequently turned out, it may be assumed that the fit which is thus described probably marks the onset of the disease. Whilst at school in the morning, the master noticed the boy acting rather strangely, for he kept rubbing out and rewriting on the slate the same word. He then seemed to be in a subconscious state saying continuously 'mother', afterwards he became unconscious and remained so for an hour, he did not bite his tongue, but passed a motion. When he recovered there was no paralysis nor could any difference in strength on the two sides be detected. Five years later I found him in Colney Hatch Asylum. His appearance was little changed, he looked about 10 years old and did not seem to have grown. The tongue was tremulous and jerky, likewise there was well-marked tremor in the lips; the speech was muttering, hesitant, tremulous, and incoherent; he partially seemed to understand what was said to him; although he did not recognize me, he knew his mother. The knee-jerks were absent on both sides; the pupils were dilated, unequal, and irregular. They did not react to light and only sluggishly in convergence. He did not respond to the calls of nature. The genital organs were quite infantile. The dementia and paresis progressed rapidly, but delusions were not observed. At the post-mortem examination exactly the same changes in the brain were found as occur in general paralysis of the adults. This case, in common with many others, exhibited the characteristic changes in the liver, spleen, and kidneys of congenital syphilis. The testicles were atrophied and showed no spermatozoa.

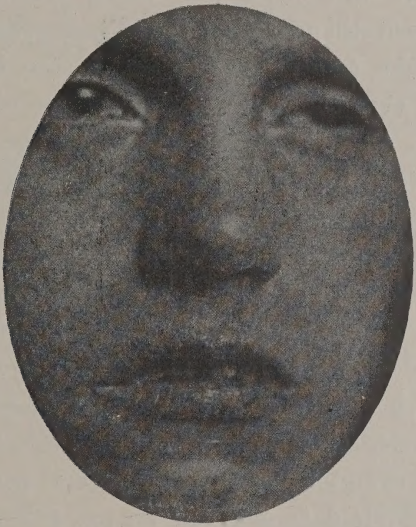

Fig. 56. A patient suffering from congenital syphilis. Marked rhagades of the lips; Hutchinsonian teeth; a squint. Case 57.

A considerable number of cases suffer with primary optic atrophy early in life and are sent to the blind schools; and then at puberty or earlier they exhibit some mental symptoms or a progressive mental enfeeblement frequently associated with lapses of consciousness or epileptiform convulsions; they are then sent to the asylum as epileptic imbeciles.

The following is an interesting case of juvenile tabes in a female which came under my observation some years ago:

Case 58. A girl, aged 9, with well-marked obtrusive stigmata of congenital syphilis in the form of Hutchinsonian teeth and rhagades, was admitted to Charing Cross Hospital for attacks of vomiting and pain in the abdomen and sometimes diarrhoea. I ascertained that the father had died at Banstead Asylum of general paralysis. There was no reference in the notes to the fact that the father had suffered with syphilis. The mother had had one miscarriage and two children born dead prior to the birth of the patient. The paroxysmal attacks of vomiting commenced at the age of 7. She was sent to Darenth and the attacks of vomiting and pain still persisted; the pupils were dilated, unequal, inactive to light and accommodation; the knee-jerks were absent. Both eyes showed well-marked choroido-retinitis and optic atrophy. There was anaesthesia of the chest to light tactile impressions from the third to the sixth rib inclusive. Her mental condition was apparently normal. She suffered with lapses of consciousness, sometimes biting her tongue and passing her urine and motions under her. There was a dorsal dislocation of the head of the right femur. There were no teeth in the lower jaw and the alveolus was so much absorbed as to resemble that of an old woman. She died after some years of tabo-paralysis showing the usual characteristic appearances in the brain and spinal cord.

The mental symptoms of juvenile general paralysis resemble those of the acquired form given on pp. 259–76. Apparently there is hardly any age at which parasyphilitic affections like tabes and general paralysis may not come on as a result of congenital syphilis (vide pp. 233, 234), but the majority of the cases show symptoms just before or at the time of puberty; the child's character changes; if it is already feeble-minded it becomes more mentally deficient, that is to say it begins to lose the little mind it possessed in its totality; if the child has shown a fair intelligence there is added to a strange and unusual behaviour a progressive dementia: the mother will tell you that her son or daughter, for no reason she knows of, is becoming silly and childish, forgetful, sometimes bad tempered and given to doing strange things, wandering from home, giving up occupation for no reason. Often a parent will tell you that the boy had a fall, and to this is attributed the mental decay that appeared to follow, but without wishing to infer that traumatism may not be an exciting cause of the onset, nevertheless it must be remembered that the disease itself may be the cause of the fall, which may have resulted from an epileptiform or apoplectiform seizure. Thus a case that I saw was attributed to the boy falling out of a van. However, he had the typical stigmata of congenital syphilis, viz. Hutchinsonian teeth, rhagades, and choroidoretinitis, and it is quite probable that he fell from the van on account of a fit, for he was insensible for some time and yet had no serious head injury to account for it. The parents may have noticed that the character has changed: from being bright and merry, the son or daughter as the case may be has become self-centred, morose, and bad tempered, or foolishly contented. They may have noticed that the facial expression has changed to one of apathy and indifference or 'silly' looking, and with this the speech has changed and the writing and spelling not so good as they once were. Since the more youthful patients are

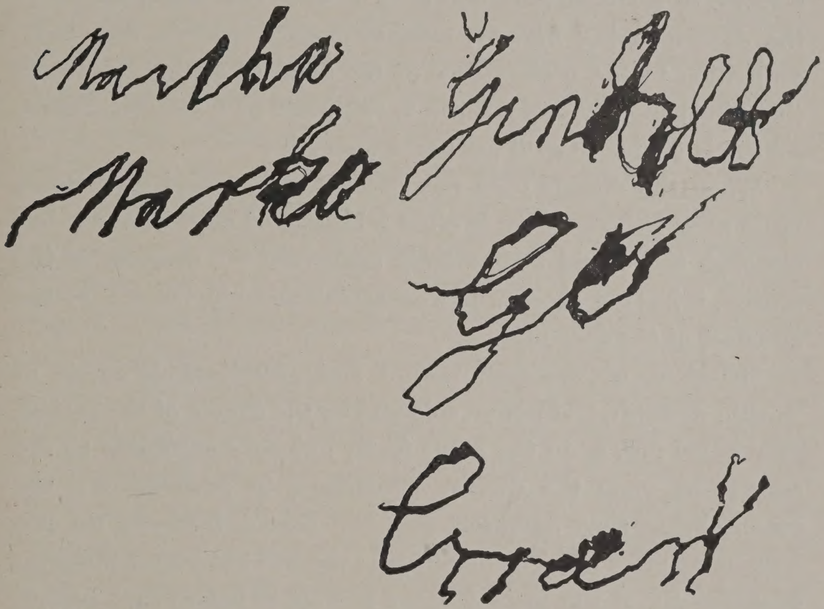

Fig. 57. Handwriting from a female juvenile general paralytic. The patient had passed the Seventh Standard at the Board School before the onset of the disease.

as a rule not anti-social, for they seldom have either grandiose delusions or delusions of persecution, it may not be until they have had serious convulsive seizures, become wet and dirty in their habits, or obviously demented, that the parents of the lower classes consult a doctor; then a history such as I have given is frequently elicited from one of the parents.

Progressive paresis and progressive dementia are constant symptoms in the juvenile cases of general paralysis. Thus the attempt of a female paralytic case to write her name, shown in the accompanying Fig. 57, exhibits tremor, paresis, and incoordination in the performance of the hand as an instrument of the mind; moreover, dementia is exhibited in a marked degree, for she is unable to spell her name correctly.

When the disease does not become pronounced until some years after puberty there is often a history of masturbation, but although this would undoubtedly aggravate the progress of the disease, it has not necessarily a causal relationship, but it is rather an effect of the dementia.

Delusions of a sexual nature and grandiose delusions of wealth, strength, and power, coloured by the events of the period, may occur just as in the adult form, but only according to my experience when the disease commences in adolescence; the reason being that ambition and the sexual instincts do not become habitual passions dominating the will until after puberty, consequently, if the mental decay has set in before that period, these cannot become a content of consciousness.

After puberty, consciously and subconsciously, these passions are in one form or another always forming a part of the content of consciousness; there may be no outward manifestation of their presence, for social amenities compel the normal individual to control, modify, repress, and silence the inmost thoughts, which nevertheless in their nakedness and crudity may for long periods form the chief content of consciousness and are ever on its threshold. But the neural structures which are the last to come are the first to go (Hughlings Jackson), and as the higher controlling centres decay and the autocritical sense is lost, then by the slightest suggestion, or even apparently without it, what is left of the psychic content bubbles forth, and what is left will be that which has by constant repetition and instinctive tendency become most fixed; now grossly exaggerated and coloured by associations which are uncontrolled, they come to resemble the fantastic fabulations which characterize some dreams.

Diagnosis. These cases commencing in adolescence may be mistaken for dementia praecox; but the signs or history of congenital syphilis, absence of hallucinations of hearing, the presence of Argyll-Robertson pupils, a progressive paresis and dementia with the characteristic affections of speech and handwriting, together with the biochemical and cytological examination of the blood and the cerebro-spinal fluid, will enable a correct diagnosis to be made. These signs and symptoms may not be so obvious in the early stages, and it may be thought that the case is one of hysteria, imbecility with epilepsy, or disseminated sclerosis, but it has been shown that the blood and cerebro-spinal fluid quite in the early stages of the disease give the characteristic antibody reaction, and lymphocytes are found in the cerebro-spinal fluid; moreover, the pupil phenomena are characteristic when associated with progressive dementia. Usually hallucinations are not present as in dementia praecox. The disease usually runs a slower and longer course than in the adult, thus it proceeds to a more complete dementia and paralysis. The patient in the terminal stage is absolutely indifferent to his surroundings, speechless, and even swallowing with difficulty the minced food with which he has to be fed; there is marked wasting and contracture of the limbs; he passes his faeces and urine under him, and dies eventually either from asthenia, septicaemia, bed-sores, bronchopneumonia or tuberculosis.

Juvenile tabes dorsalis is much rarer than juvenile general paralysis, but the number of recorded cases is steadily increasing. The reports of the recorded cases usually show that the patients were the subjects of congenital syphilis or the history pointed to the parents having suffered with syphilis (vide p.232); in some of the cases the history pointed to acquired syphilis at an early period of life, often through a syphilitic wet nurse (extra-genital infection). In some of the cases one of the parents has suffered from either tabes or general paralysis. Williamson records three cases and gives a short abstract of a number of recorded cases.

PROGNOSIS IN DISEASE OF THE NERVOUS SYSTEM DUE TO CONGENITAL SYPHILIS

As in the adult disease of the nervous system due to acquired syphilis, so in the congenital form prompt and active antisyphilitic treatment may be attended with remarkably favourable results. The first point, however, to attend to before giving a prognosis in nervous disease arising in later childhood or early adolescence in a subject of congenital syphilis, is to determine whether the symptoms indicate syphilis or parasyphilis of the nervous system or are merely coincident; this can be done by attention to the symptoms, their mode of onset and progress, and their response to antisyphilitic treatment. Moreover, the greatest help can be obtained by the examination of the blood and cerebro-spinal fluid by microscopic and bio-chemical methods. Parasyphilitic affections are invariably progressive; when the brain is affected they are usually fatal within four or five years of the onset of definite symptoms of dementia and paresis, and they are uninfluenced by treatment. In other parasyphilitic affections, for example, optic atrophy and tabes, the prognosis, although not so bad as regards duration of life, yet offers an outlook most unfavourable, for many of the cases end in dementia paralytica and others terminate eventually in complete helplessness from blindness, imbecility, or other causes.

In the case of nerve-deafness it is seldom that treatment does any good and the patient will become stone deaf. If, however, the child has learnt to speak and read for some years, as is usually the case, then in spite of the deafness it retains its speech faculties.

In cases of vascular and meningeal syphilitic inflammatory conditions the prognosis is more hopeful than in parasyphilitic affections, for they improve remarkably under treatment, but post-mortem investigation shows again and again the existence of widespread morbid processes which have left their scars if they are not even still active or capable of re-activation. If the disease can be treated in the early irritative stage, when convulsions occur and paralyses have not yet taken place, the prognosis is much more hopeful, for there can be no question that mercury and iodide, energetically but judiciously administered, will stay further progress and lead to a disappearance of symptoms. When, however, there is a hemiplegia it means destruction by softening occasioned by thrombotic sclerosis of vessels, and not only is the chance of relief by treatment less, but the probability of other vessels being similarly affected much greater.

Psychical symptoms, whether mania and motor restlessness, or somnolence and drowsy stupor, are of grave omen; for the tendency is to dementia.

Treatment. On many occasions previously I have pointed out the probability that, simultaneously with the appearance of the exanthem, there is a possibility of affection of the meninges; therefore the disease should be treated in the earliest periods of infancy, so that the living virus may be inhibited in its growth; thus there will be less chance of the blood *infecting* vital structures, such as the central nervous system. Children, even young infants, are very tolerant of mercury and there is no better mode of treatment than by mercurial inunction. A half-drachm of oleum cinereum or lanolinum hydrargyri may be inuncted in different parts of the body daily. Grey powder gr. i. t. d. s. may be administered if thought desirable. Later the syrup of the iodide of iron will be found useful, but the administration of mercury is the necessary treatment to be effectual. Many cases of affection of the nervous system later in life might never have occurred if the infants had been treated judiciously with mercury for a year or two instead of a month or two. The same treatment should be adopted in *syphilis hereditaria tarda* and continued with periodic remissions for several years. In juvenile parasyphilitic affections I have never seen any benefit derived from antisyphilitic treatment; it may be given a trial in some selected cases, but disappointment at the result must not be felt if it is without benefit. There is little more to be done for parasyphilitic affections due to congenital syphilis than for the similar affections occurring in adults as a result of acquired syphilis, and the same general principles for treatment (vide pp. 459–84) hold good.

Hutchinson remarks : ‘ Some of the most noteworthy of our therapeutic triumphs are often obtained when mercury is judiciously employed for infants who are the subjects of syphilitic cachexia.’ They fatten and thrive under it, but he also expresses the necessity of caution not to use mercury too vigorously, for he thinks that its use in infancy is very injurious to the second set of teeth. However, this warning should not deter us from administering mercury, for the syphilitic virus is much more likely to destroy the enamel germs than the mercury.

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CHAPTER XII

THE TREATMENT OF SYPHILIS OF THE NERVOUS SYSTEM

The first duty of a medical man is to prevent disease, failing that to cure disease, failing that to prolong life and relieve suffering. This aphorism of Sir William Jenner will form the basis of the discussion on the general treatment of syphilis of the nervous system.

The prevention of disease. The full discussion of prophylaxis will be found in vol. vi of this 'System of Syphilis'. I shall only deal with the subject in its more limited scope regarding the measures which should be adopted to avoid the affection of the nervous system in a person the subject of antecedent syphilis.

All cases which tend to produce a *locus minoris resistentiae* in the nervous system will predispose to syphilitic and parasyphilitic affections; thus alcoholism, lead, and other toxic conditions, head and spinal injuries, sexual excesses, violent emotional disturbances, prolonged grief, worry and excitement, with the associated insomnia, all tend to act as important contributory co-efficients in the production of nervous diseases, especially the late degenerative parasyphilitic forms. The causes, which in a non-syphilitic person of inherited neurotic or psychopathic temperament tend to spinal or cerebral neurasthenia, should so far as possible be averted by such an individual if he be the subject of antecedent syphilis. It is undoubted that next to syphilis, alcohol is the most dangerous, as it is the most prevalent of all poisons acting on the nervous system; unlike syphilis it does not multiply in the body like a living virus. The noxious influence of the abuse of alcohol may be direct on the nervous system, but it also acts indirectly by diminishing the vital resistance of the living tissues against organisms which invade the tissues of the body or have established themselves in the tissues of the body, e. g. syphilis and tubercle. We have every reason to believe that the syphilitic neoplastic formations are caused by the specific organism, and the endeavour must therefore be made to render the organism innocuous and arrest its colonization in all those places where it makes its presence known by exciting morbid changes. To do this effectually, however, measures have to be employed which affect the body *in toto*, that is, a general treatment must be instituted.

How far energetic and continuous mercurial treatment may diminish the liability later to the development of syphilitic and parasyphilitic affections of the nervous system will be considered later; it will not be out of place before leaving the subject of prophylaxis to point out how very important it is to lay down rules and directions to persons who are the subjects of syphilis, and I cannot do better than quote the practice adopted at the Hamburg General Hospital St. Georg, where the following printed rules are given (Max Nonne).

1. You are suffering from a venereal disease, syphilis; your disease is infective and remains so for some years.

2. You must therefore take care that you do not convey your disease to others, which may happen by sexual intercourse, by kissing, or by sleeping in the same bed with others, or by using the same eating and drinking utensils.

3. Your disease is not curable by a single course of treatment.

4. At some future time it is probable you will suffer from traces of the disease, e. g. ulcers in the mouth, pains in the neck, or eruptions on the body, squint, headache.

5. As soon as you notice any symptoms you must at once return to be again treated.

6. Take no notice of so-called 'nature cures' or homoeopathic treatment. For the only way to be cured is that which will be adopted by a properly qualified medical man.

7. Even if you notice no new phenomena of your disease you ought to consult a medical man every four months in order perhaps to receive another course of treatment.

8. This course need not necessarily be made in a hospital; you will in all probability be able to continue at your work.

9. Only when about three years have passed will it be safe for you not to undergo regularly several times in the year a course of treatment, and you will probably thereby be saved from later serious disease of bones, nerves, spinal cord, and brain.

10. Four to five years after infection and only after obtaining permission of the doctor will it be safe for you to marry. If you marry before you may communicate the disease to your wife and to the children.

11. A complete cure may be expected if you attend to all the directions given.

12. Keep this card and show it to the doctor whom you may later consult, also always ask his advice. Show the card to no one else.

(Addition) Take care to keep your teeth clean by brushing them twice a day; rinse the mouth after each meal. Live a simple, regular, abstemious life.

Mercury has long been recognized as a specific agent in the cure of syphilis, and most authorities agree that treatment by mercury in a systematic manner, such as above indicated, diminishes the probability of nervous disease arising from the syphilitic affection. Still a very large number of individuals who suffer with syphilis are either not treated at all or only inadequately treated, and yet do not suffer with disease of the nervous system; while a number of persons, though not so large a percentage, although treated for years with mercury, suffer from syphilitic disease of the brain and spinal cord and from tabes and general paralysis. It must, therefore, be conceded that the fluids and tissues of the body have the power of destroying the living organism and modifying or neutralizing the toxins it may produce. While admitting this, all the facts prove that mercury has a specific influence upon the syphilitic virus although exactly how it operates is still a matter of conjecture; it may act by stimulating the cells of the body to increased activity in the production of lysins and antitoxins; or, as seems probable, it lowers the vitality of the spirochaetes so that the tissues can more easily destroy them; the tissues and fluids of the body must, however, play an important part in the cure. Probably a certain racial immunity is set up in nations that have been widely syphilized for many generations, and individuals with an inherited immunity get well without mercury; but Von Düring's observations in Turkish Asia Minor show that the *vis medicatrix naturae* has apparently done very little to *avert* the effects of syphilis in a race racially infected. Also, Colonel Lambkin's experience in Uganda supports this fact.

The experiments of Metchnikoff ('System of Syphilis,' vol. ii, p. 180) tend to show that syphilis may be prevented by mercurial inunction of the point of inoculation an hour after infection; it would therefore seem that mercury is capable of killing the living virus when brought into contact with it. Doubts, however, have been thrown upon these experiments by the observations of Levy, Bing, and Gaucher, also by the experiments of Neisser on apes. However, the rapid effects of mercury in the cure of syphilitic eruptions and in cases of gummatous meningitis point to a direct specific action on the virus. It is now generally recognized that the successful therapy of syphilis consists in the administration of mercury in such a way as to combat the syphilitic virus without causing injury to the patient by the poisonous effects of the drug. It may be introduced into the system by (*a*) the alimentary canal, (*b*) by the cutaneous surface, (*c*) by the subcutaneous tissues. It is generally admitted that metallic mercury in a fine state of division has a more durable action than when administered in other forms; it has been shown that mercury may be detected in the urine two and a half years after a course of inunction (Lang). It may be supposed, therefore, that the mercury is retained in the tissues and slowly but continuously passing into the circulation is eliminated by the kidneys. According to some observers the mercury circulates in the blood plasma in the form of chloro-albuminate; according to others it is contained in the leucocytes as reduced mercury in a fine state of division. Mercury administered in a soluble form has therefore a less continuous action than when administered in an insoluble form and deposited in the cells and tissues to be slowly but continuously drawn upon by the circulating fluids of the body.

Before commencing to treat a patient with mercury the following precautions should always be taken: The urine should be tested; if there is albumin great care must be exercised in the administration of mercury; it may happen that the albumin is due to a syphilitic affection of the kidneys, and under careful treatment by mercury the albuminuria may improve; just as we find an anaemia due to syphilis will improve with mercury. But too much caution cannot be exercised in the administration of mercury when there is any evidence of kidney disease; for it must be remembered that the mercury is eliminated from the body by the kidneys. The teeth and gums should be examined; often from neglect in taking precautions a stomatitis occurs long before sufficient mercury has been ingested to control the action of the syphilitic virus. It may be desirable to send the patient to a dental surgeon and thus avoid the vexation of having to give up treatment before there is sufficient mercury in the system. It is well to inform the dentist that the patient is suffering from syphilis.

The patient should be told to rinse the mouth with a lotion of ʒ½ to ʒj of chlorate of potash in six ounces of water after each meal, and the teeth should be brushed twice a day, using some antiseptic dentifrice, e.g. euthymol, soap, and camphorated chalk with hot water. Patients should always be cautioned of the possible occurrence of stomatitis, and at the same time told to discontinue the mercury if the gums become sore or it hurts on biting a crust. A caution should be given about smoking, for if excessive it is liable to cause pharyngitis and mouth troubles.

Gastro-enteric symptoms. Mercury administered by the mouth in any of its forms is more likely to cause dyspepsia, colic, and diarrhoea; gastric and intestinal complications are more likely to occur with the perchloride and green iodide, unless it is made with excess of metallic mercury, than other preparations of mercury. Cholate of mercury ½ grain, Tannin albuminate 1 grain (Mergal) is a useful non-irritant preparation. Beer or stout will often produce mercurial diarrhoea.

Cutaneous eruptions. Erythematous rashes may appear but are rare; accompanying mercurial rashes there is generally some pruritus and febrile symptoms; rashes, when they occur, are generally due to some idiosyncrasy on the part of the patient.

Nutritional disturbances. Anaemia, emaciation, and languor from disturbance of nutrition may be the result of too prolonged and vigorous mercurial treatment, and Lang calls attention to the special danger of mercurial treatment in cases where there is a haemorrhagic diathesis, since a pernicious anaemia may be induced if care be not exercised. The patient should be weighed periodically, and if there are any signs of anaemia a blood count should be made.

Patients suffering from tuberculosis, malaria, alcoholism, diabetes, and cachaxia, are subjects in which the mercury must be administered with great caution, otherwise there may be an aggravation of the disease. Having taken due note of these precautions we can now pass on to the various methods by which mercury can be used for the prophylactic and curative treatment of the disease.

Neuritis mercurialis. The question whether a mercurial polyneuritis may occur has been discussed by various authorities; if such cases do occur they are extremely rare, and Max Nonne asserts that he has not seen a single case in his hospital experience and private practice of nineteen years' duration.

Methods of Administration of Mercury

There are three principal methods by which mercury may be introduced into the system, which will be briefly described; but the reader should consult 'The Treatment of Syphilis,' 'System of Syphilis,' vol. ii.

1. The external or inunction method.
2. The internal or ingestion method.
3. The method of intramuscular injection.

Inunction. The method which I usually adopt is that of inunction, as it is the simplest and least likely to be attended with complications. The best ointment to use for inunction is the *Unguentum Cinereum*, composed of equal parts of mercury and lanoline, with a sufficiency of olive oil. The following method recommended by Lang can be followed with advantage. About 1 drachm of this ointment is rubbed daily or every other day into a fresh part of the skin for fifteen to twenty minutes ; in children half that quantity can be used. The more the hairy parts of the skin are avoided the better will the inunction be borne, and the softer and more supple the skin the greater will be the rapidity of absorption ; it is therefore desirable that the patients have a warm bath before the ointment is rubbed in. A fresh region of the skin surface is selected each day, and to facilitate this and reduce it to a system, Lang recommends the skin surface to be divided into regions and the inunctions are then made in the following order : first inunction, the flexor surfaces of both forearms ; second inunction, the flexor surfaces of both legs ; third inunction, the flexor surfaces of both arms ; fourth inunction, the inner surfaces of both thighs ; fifth inunction, both groins ; and sixth inunction, the back. This cycle may be varied if desired ; the attendant or nurse may wear gloves of leather or rubber or an inunctor may be used. Inunction is better performed at night before the patient retires ; much sweating is undesirable. Patients who are otherwise strong enough may inunct themselves.

Colonel Lambkin points out that the professional rubbers at Aix use no artificial protection to the hands ; they maintain that the rubbing can be far more effectually carried out by the bare hands than by any artificial means. He states that his experience at the Military Hospital, Rochester Row, where the Aix treatment is carried out, confirms this.

Eczematous eruptions sometimes occur rendering this mode of treatment undesirable, likewise erythema.

The method may be employed in children, adults, and the aged. Mercury administered in this way is only very slowly eliminated. It is often advisable to give iron by the mouth at the same time as inunction.

Well-to-do patients can be sent to Aix-la-Chapelle ; the advantages are as follows : the inunction is performed by a professional rubber, and this treatment is combined with sulphur baths, and the drinking of the sulphur waters. It is claimed that under the influence of the sulphur waters the mercury is converted into a sulphate of mercury and that this leads to better absorption of the mercury. One advantage is the patient is not worried with the fear that his friends will suspect the nature of his disease from the treatment he is receiving. Another advantage is the régime, diet, and early hours to bed. At the same time it may be mentioned that the inunction treatment can be carried on quite as successfully in this country if necessary.

The advantages of mercurial inunction over ingestion are its freedom from gastro-intestinal disturbances and its greater rapidity of action; its disadvantages are inconvenience and the suggestion it affords to the friends of the patient of the nature of the disease from which he is suffering. The duration of the inunction treatment, the number of rubbings and the quantity of ointment to be used each day vary according to the severity of the symptoms and the tolerance of the drug; attention should be directed to the condition of the mouth and the gums, as well as the freedom of the urine from albumin. Generally speaking a course of twenty to thirty rubbings may be prescribed, and after an interval of a week or ten days another such course may be advised. Some authorities, after a completion of the cycle of rubbings, allow an interval of one or two days before restarting. It is not a bad plan after a course of rubbings not to give another, but let the patient wear a flannel sachet next the skin in the inner surface of which a little grey oil is occasionally placed. The so-called merco-lint may be used in the same way. Some authorities assert that mercury thus administered is not absorbed by the skin but by the lungs in the form of vapour; this hypothesis, however, is not generally accepted, for mercury has been shown to penetrate the skin; the examination of the tissues of persons who have died, having been treated before death by inunction, proves this; moreover, confirmation of this fact has been obtained by experiments on animals. 'Although a certain amount of mercury when spread on the skin becomes volatilized, this amount will not account for the rapid effect produced by mercurial inunction' (Marshall).

Ingestion. When inunction cannot be used and injections are objected to by the patients, mercury may be administered in the form of pills, powders, or mixtures. In England the Pil. Hydrarg. in combination with a small quantity of opium or the Pulv. Hyd. c̄ Creta, the proto-iodide of mercury (green iodide), and the tannate of mercury are used; 1 or 2 grains of Pulv. Ipecac. Co. may be added to prevent diarrhoea. Sir J. Hutchinson has recommended Hyd. c̄ Creta and Pulv. Ipecac. Co. āā gr. ij t.d.s. in the form of pill. If pills are given it is very necessary to tell the patient to obtain them fresh from a good druggist; in fact Lang recommends a pill that will melt at the temperature of the body. A grain of pepsin may be added to each pill. The tannate of mercury has been recommended, for it is said that it is not absorbed until it reaches the intestine, and therefore it does not produce gastric irritation. Salicylate of mercury in doses of $\frac{1}{4}$ to $\frac{1}{6}$ gr. in pill has also been recommended. Personally I prefer either blue pill or grey powder combined with a small quantity of opium. Tannin Albuminate gr. $\frac{1}{2}$ may be given in capsules, one capsule three times a day. It is claimed for this preparation that it does not produce gastro-intestinal disturbance. Again, I frequently prescribe Liq. Hyd. Perchlor. ʒj and Pot. Iodid. gr. x–xx gr. in combination with Tinct. of Cinchona and Decoction of Sarsaparilla in tertiary syphilis of the nervous system. When mercury cannot be tolerated by the mouth and injections or inunctions are impracticable, suppositories of grey oil 40 per cent. in various strengths may be employed. Audry claims to have treated cases successfully in this way and Pernet states this method is given in Bryant's *Surgery*, 4th edition, and therefore is not new. There are many objections to the internal method of administration of mercury, vide 'Treatment of Syphilis', vol. ii, p. 273.

Intramuscular Injection. Mercury may be administered by injection of either *soluble* or *insoluble* preparations of the metal; the advantage of the use of the latter is that their injection need only be performed once a week; whereas the former should be injected every day or every other day. The advantage of injection over other methods is that the drug rapidly acts upon the syphilitic neoplasm, and where the symptoms are urgent, as in the following case, the method of injection is strongly to be recommended.

In very grave syphilitic affections of the nervous system recourse may be had to a simultaneous energetic mercurial and iodide treatment, administering the mercury in the form of injections or inunctions while the iodide is given internally. We may thus be able to avert serious consequences and even a fatal termination, as the following case shows.

Case 59. W. S., policeman, aged 46, syphilitic infection twenty-three years previously. No history of fits in family, nor any nervous disease. Has had peripheral facial paralysis from infancy. While on duty he had a fit, lost consciousness, and was brought to the hospital by a comrade. During the first nine days he was in the hospital he had over 400 fits. Each fit lasted altogether about two minutes. He does not lose consciousness, but is only semi-conscious. The fit commences with conjugate deviation of the head and eyes upwards and to the left, followed almost immediately by twitching of the left side of the face, clonic spasms of the left arm, which is in a semi-flexed position, and quite rigid. There was slight contraction of the right arm at the shoulder and both legs. Between the fits the head and eyes deviated to the right (paralytic exhaustion). Left arm is weaker than the right. Legs: no obvious paralysis or paresis. Reflexes, both knee-jerks slightly exaggerated. Left ankle clonus more than right. Superficial plantar, left absent, right present. Memory good. Treated at first with chloral hydrate and bromide. I was consulted and at my suggestion he was put on frequent intra-muscular injections of metallic mercury and large doses of iodide. A blister was placed over the shaved scalp, corresponding to the lower part of the right motor area. From this time the fits began to diminish, and a few days later ceased. He was discharged three weeks after admission; subsequently he attended my out-patients' department. He was able to earn his living as a caretaker.

The following soluble and insoluble preparations for injections have been recommended by Mr. Campbell Williams :—

Soluble Salts—Aqueous Medium.	*Insoluble Salts—Oleaginous Medium.*
℞ Hydrarg. sozoiodol. . . grs. $2\frac{1}{2}$ Sod. iodidi. . . . grs. 5 Aq. dest. . . . ♏100 Dose 10 to 20♏, containing $\frac{1}{4}$ to $\frac{1}{2}$ gr. of the salt.	℞ Hydrarg. salicylatis neut. grs. 10 Paraffin liq. . . . ♏100 Dose 3 to 10♏, containing respectively $\frac{3}{10}$ to 1 gr. of the salt.
℞ Hydrarg. succinimid. . grs. $2\frac{1}{2}$ Aq. dest. . . . ♏100 Dose 10 to 20♏, containing $\frac{1}{4}$ to $\frac{1}{2}$ gr. of the salt.	℞ Hydrarg. . . . grs. 10 Adipis lanae anhyd. . . grs. 30 Paraffin liq. (carbolized 2 per cent.) . . ♏100 Dose 10♏, containing 1 gr. of the *base*.
℞ Hydrarg. lactatis . . grs. $2\frac{1}{2}$ Aq. dest. . . . ♏100 Dose 10 to 20♏, containing $\frac{1}{4}$ to $\frac{1}{2}$ gr. of the salt.	℞ Hydrarg. subchlor. (calomel) grs. 5 Ol. olivae (sterilized) . ♏100 Dose 10 to 15 or even 20♏, containing respectively $\frac{1}{2}$, $\frac{3}{4}$, or 1 gr. of the salt. NOTE.—The larger quantities must be given most cautiously. The intense pain following its injection may necessitate a local hypodermic of $\frac{1}{4}$ gr. morphia.
℞ Sal alembroth . . grs. 5 Aq. dest. . . . ♏100 Dose 10♏, containing $\frac{1}{2}$ gr. of the salt.	

He recommends the sozoiodolate preparation on account of its safety, efficaciousness, and the comparative absence of local pain following its injection. The solution is best when freshly prepared ; it is advisable therefore to order only small quantities at a time from the chemist.

The insoluble preparations which may be used for injection are grey oil, calomel, salicylate of mercury, and thymol-acetate of mercury. The soluble preparations which are in use are biniodide, perchloride, benzoate, cyanide, succinimide, cacodylate, sozoiodolate, lactate of mercury, and sal alembroth. Advantages are claimed by various authorities for each of these preparations. Some prefer to make the injection intramuscular, the gluteal region being chosen ; others, like Lang, who always uses grey oil as injection, prefer the subcutaneous tissues of the back.

The following precise technique for intramuscular injection may be followed with advantage :—

1. The site usually chosen is the posterior third of the buttock so as to avoid the sciatic nerve and vessels.

2. The injections should be made deeply into the muscle using each buttock alternately.

3. The syringe and piston should be of glass, so as to be easily sterilizable, and the needle should be of platinum iridium and about 1½ inches long.

4. The skin should be washed with ether soap, which is washed away with freshly boiled water, and afterwards swabbed over with carbolic or some other antiseptic solution. Both the needle and syringe should be sterilized.

5. After insertion of the needle, the piston of the syringe should be slightly withdrawn and if any blood appears the needle should be reinserted so as to avoid injection into a blood-vessel.

The syringe is then detached from the needle and charged with the sterilized mercurial preparation, all air being driven out, reattached to the needle, and the contents slowly and firmly injected; a little acetone collodion and wool may then be applied at the point of puncture.

Lang introduced the injection of oleum cinereum for the routine treatment of syphilis; he points out that there should be a limit to the number of injections of grey oil and to the frequency of their repetition, since the mercury is usually absorbed slowly and its cumulative effects might be serious. A skiagram of the buttock will show that the first injection still gives a shadow at the time the last one has been put in. A change from cold to hot weather may lead to excess of absorption, and stomatitis has been known to occur in consequence. The method has been extensively employed by Colonel Lambkin in the treatment of syphilis in the British army.

Lambkin's most recent formula is as follows :—

Pure metallic mercury . . .	10 grams.
'Creo-Camph.'[1]	20 c.c.
Palmitin basis to 100 c.c.	

10 min. contain 1 grain of metallic mercury.

Lambkin's grey oil or mercurial cream requires careful preparation, and Campbell Williams informs me that the advantages of intramuscular injections of these preparations are great, not only for the services but also for civil private practice. The patients must be properly selected, and by giving one injection a week in a series of six, eight, or more, as the case may be, one is sure of introducing a sufficient quantity of mercury. This mode of treatment requires careful watching.

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[1] Equal parts of absolute creosote and camphoric acid.

Among the other insoluble preparations are calomel, salicylate, and thymol-acetate of mercury. Neisser recommends injections of these substances first, followed later by calomel.

Calomel injections are the most powerful method of administering mercury, and may be useful in urgent cases where a rapid effect is required such as severe cerebral or spinal syphilis. Calomel may produce a great deal of pain in some subjects; it is claimed that the association of guaiacol and camphor with olive oil obviates this objection. Campbell Williams states that the pain produced by calomel is mainly due to mechanical causes which can be in great measure obviated by careful trituration. He has found this prepared salt most rapid and useful in doses of $\frac{1}{6}$ to $\frac{1}{4}$ grain up to $\frac{1}{2}$ grain or even in 1-grain doses, suspended in liquid paraffin, but great caution is required with the higher dosage as salivation is liable to be rapidly induced. Colonel Lambkin recommends a combination of creosote and camphor to prevent pain; he does not consider that it should be employed as a matter of routine, p. 294, 'System of Syphilis', vol. ii.

The following is the formula he recommends:—

℞ Calomel 5 grms.
Creo-Camph. 20 cc. $\left\langle \begin{matrix}\text{Creosote}\\ \text{Camphoric acid}\end{matrix}\right\}$ Equal parts.
Palmitin basis to 100 cc.

10 min. equals a half grain of calomel. Dose 10–15 min. as an injection once a week for not more than four weeks in succession.

The main objection to the use of soluble injections is that, although rapidly absorbed, they are rapidly eliminated, so that they have to be repeated daily or every alternate day. The injections may be followed by pain, consequently frequent repetition may render their use more objectionable to the patient than grey oil; they are, however, more easy to handle. Among the best preparations are the sozoiodolate, succinimide, lactate, and benzoate. Half a grain of the sozoiodolate may be injected once a week or more frequently if the symptoms are urgent. It is less painful on the whole than the perchloride. ‘Benzoate of mercury may be employed in daily doses of 2 centigrams, that is 2 c.cm. of the hypertonic benzoate of mercury, as used in France with good results. As compared with grey oil or mercurial cream, this daily injection is a drawback in ordinary private cases, but it is of great service to combat severe symptoms, especially with the patient in bed at home or in hospital’ (Pernet). Mercurial injections, although they have not superseded the older methods of treatment, are very useful in certain cases under certain circumstances.

Of the intravenous injection method of Bacelli I have had no experience, and as there are so many safer methods of getting a patient rapidly under the influence of mercury I should not myself adopt it.

In selecting the mode of administration of mercury the age, condition, urgency of symptoms, and social circumstances of the patient must be taken into consideration.

It may finally be remarked that the treatment of congenital syphilis by mercury is usually most satisfactory. Infants stand mercury remarkably well, and grey powder in 1-grain doses may be administered. Grey oil or mercurial ointment may be placed in a flannel binder. In the treatment of syphilis I am inclined to follow Lang. ‘All the circumstances should be carefully studied in each individual case before the form of medicament is chosen. At the same time we should not forget that individual patients (vide Case 1, p. 10), especially those who have received an overdose of mercury and iodide, are most certainly restored to health by keeping from them the specific remedies, especially mercury. We must learn to individualize and exert the greatest care in each separate case. The greater number of patients who have in the beginning undergone a rational hygienic and therapeutic treatment may expect a perfect cure. Medical supervision is nevertheless strongly to be recommended for a long period, so that the first appearance of any relapse may be at once detected. Those patients usually fare the worst who are continually changing their doctor.’

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CHAPTER XIII

GENERAL TREATMENT, PROGNOSIS OF SYPHILITIC DISEASES OF THE NERVOUS SYSTEM

THE general treatment of syphilitic diseases of the nervous system is based upon the same principles that serve as the guide to treatment in non-syphilitic diseases. The diet should be nutritious, easily digestible, and non-stimulating; as a rule alcoholic drinks should be avoided or only given in small quantities to aid digestion or to improve the circulation. When the patient is suffering from bulbar symptoms great care must be exercised in feeding; soft moist food should be given, and meat or food requiring mastication should be minced or made into a paste, otherwise alarming symptoms may arise from choking; fluids are better given with a teaspoon than by a feeding-cup. There is always a danger of fluids passing into the air-passages, and owing to the insensitive condition of the mucous membrane or the paralytic condition, the protective expulsion by coughing either does not occur or is ineffectual. Especially should great care be exercised by the nurse in feeding patients in a semi-conscious, somnolent condition; inhalation broncho-pneumonia is a frequent cause of a fatal termination from neglect of these precautions. In the semi-conscious condition or coma, it is better to administer no nutrient fluids by the mouth; if they are necessary they can be given in the form of enemata.

In severe cases the patient should be put to bed, the room should be darkened and noise and excitement of all kinds avoided; these precautions are particularly necessary in brain cases; it is desirable, moreover, to allow only the nearest relatives to see the patient, and in many cases, especially where there is delirium, it is better for these visits to be occasional and brief;

it may be advisable in some cases, with mental symptoms, to exclude all persons except the attendants in charge.

The successful treatment of the case not only depends upon the early diagnosis and antisyphilitic treatment, but also upon good nursing by which complications may be avoided ; the most important of these besides broncho-pneumonia are bed-sores and cystitis. The nurse in charge should be particularly cautioned against the dangerous results which may arise from neglect of the following precautions. The patient, if helpless and bedridden, should be placed on a water bed as soon as possible ; sometimes this is not possible or the patient feels it so uncomfortable as to object to its use, and then greater care must be exercised in avoiding continuous pressure upon one spot. Bed-sores are especially liable to form over the sacrum and spread rapidly in cases of spinal paraplegia, and sometimes in spite of all precautions a bed-sore occurs.

The back, the heels, and buttocks should be examined daily, and a red spot appearing should always be a danger signal to a good nurse, who will immediately on its discovery call the doctor's attention to it. The doctor should satisfy himself at his visits that there is no such condition, or if there is, he should immediately take measures to prevent further developments. The skin, especially of parts subjected to pressure, should be washed daily with soap and water and moistened with spirit or Eau de Cologne, finally carefully dried and powdered with kaolin or zinc oxide. One of the most fruitful causes of bed-sores is carelessness in allowing the patient to lie on sheets soiled with urine and faeces. Since incontinence of the bladder and bowels is so frequent in paralytic conditions, measures must be adopted to prevent the patient lying in decomposed urine and in faeces. Urinals fixed on the penis are objectionable ; sometimes, owing to the organ being continually exposed to the action of decomposing urine, sloughing of the foreskin and other complications may arise. It is much better to arrange absorbent antiseptic wool or oakum under the perineum in such a way that it may collect and absorb the urine and faeces which escape in consequence of paralysis of the sphincters or incontinence.

When a patient smells of decomposing urine and faeces the doctor himself should investigate the cause and see whether every precaution is being taken.

In spite of all precautions by doctors and nurses bed-sores will occasionally arise, and they call for energetic measures or the septic process may rapidly spread to the bone and membranes, causing an infective spinal meningitis. When a red spot appears, zinc ointment may be applied on lint fixed with plaster, and the patient should be so arranged in his bed that pressure is taken off the inflamed spot. Should a slough be formed and a septic process of ulceration invade the subcutaneous tissues, boracic acid fomentations, or charcoal poultices may be used; they should be continually changed and every endeavour made to get a healthy granulation-tissue formation. I have seen huge sacral bed-sores get well with this treatment, when the spinal cord symptoms improved under the influence of mercury.

Even more common and quite as dangerous as the occurrence of bed-sores is cystitis from retention and decomposition of the urine in the bladder; this may be the result of catheterization, but it often occurs in cases, e.g. tabes dorsalis and meningo-myelitis, where the catheter has never been used. The occurrence of intermittent pyrexia should always suggest to the mind of the practitioner the probability of a septic condition of the bladder which may if neglected go on to a fatal pyelo-nephritis. In every case the condition of the bladder should be determined; the dribbling away of water continuously in a semi-conscious patient may really be due to retention of urine, and the patient, not being in a fit state of mind to complain, may be suffering from a greatly distended bladder. I have seen such cases in which the bladder has reached to the umbilicus; the use of the catheter therefore may be required, and if it is, great care should be exercised in seeing that it is quite sterile. Should cystitis have occurred owing to the residual urine having undergone decomposition and the water passed be ammoniacal and alkaline, immediate measures should be taken to combat this condition before it sets up a secondary pyelo-nephritis. The bladder should be washed out daily with a weak boric acid solution, followed by injection of 4 or 5 oz. of peroxide of hydrogen, 10 vols. Urotropine 10 grs. combined with half to one drachm of borocitrate of magnesia or acid phosphate of soda should be administered three times a day. By this treatment the cystitis can usually be cured. The bowels should be attended to; in some cases there is obstinate constipation and purgatives are required; the mercury which is administered, however, usually acts upon the bowels, and diarrhoea or looseness of the bowels often requires to be checked by astringents or enemata of starch and opium.

When the active antisyphilitic treatment is no longer indicated, it may be desirable to administer iron and bitter tonics. Strychnine should, however, not be used where there is much spasticity of the muscles. Arsenic in small doses is useful in some cases.

There is often a considerable neurasthenic halo to the organic disease caused by syphilis, and the treatment of this may lead to great improvement in the condition of the patient. A very good nerve tonic is Acid Hydrobromic dil. ♏xxx combined with Tinct. Nucis Vom. ♏v, ♏x and Tinct. Quininæ ʒss–ʒj. t.d.s.

When there is hemiplegic or paraplegic contracture a great deal of improvement in power can be obtained by massage and passive movements; the patient should be instructed to will the movement which is being performed by the operator; he is to try and assist in the movement; in this way the path to the limb from the brain may be reopened or a new path established. I am convinced that this practice materially aids in the restoration of movement. A great deal of the immobility of limbs comes from disuse of the limbs and neglect to free the joints. Munk showed that monkeys which had been rendered hemiplegic by removal of the motor cortex recovered movement in the limb if they were placed with other monkeys in a large cage and perforce had to use their limbs to spring about. Another practical hint which I have found most useful in restoring movement in the lower limbs in paraplegia is always to take off the weight of the bed-clothes by a cradle and wrap the limbs in wool or woollen knitted stockings and prevent foot-drop by a support against the soles of the feet; in this way contracture of the calf muscles is prevented. Massage and movements may be undertaken when the acute symptoms have passed off, and as soon as possible the patient should be encouraged to put the feet on the ground and learn to walk, holding on to the back of a wheel chair. Some authorities recommend the use of the Turkish bath for contracture. A simple expedient is to place several electric lamps on the cradle in the bed; this produces a local sweating and relaxation of the contracted muscles. I have seen patients bedridden and helpless in consequence of neglect of these simple precautions.

Insomnia and restless motor activity may necessitate the use of hypnotics and narcotics. The warm bath sometimes will give sleep and quiet the restlessness. Among the drugs used to produce sleep may be mentioned sulphonal, veronal, trional, bromurol, chloralamide, bromide and chloral, bromidia (which consists of bromide, chloral and tinct. cannabis Ind.), paraldehyde. When the insomnia is due to pain these remedies are usually inefficient and it is necessary to give morphia hypodermically, by mouth or suppository; the last-named mode of administration is useful for pains in the pelvis, back, or sacral plexus. It is very essential to keep the patient warm and he should wear flannel or woollen underclothes, and if he is well off he should be recommended to pass the winter in a warm, dry, equable climate. When convalescent it is very essential to point out to the patient that however well he may feel, he has an invalid nervous system, and he should avoid all causes of stress, mental or physical, and he must lead a regular, simple life; particularly he should avoid the abuse of alcohol and sexual excesses.

The subjects of syphilis of the nervous system become very depressed, and much good may be done by putting a cheerful complexion on the case and telling the patient that you have good hopes of his making a perfect recovery, or at any rate such an amount of recovery may be expected as will enable him again to resume his occupation and lead a useful life. This prognosis is quite justifiable, for it is astonishing how much recovery sometimes occurs under proper treatment even in comparatively hopeless cases.

In cases where epileptic fits have supervened on old syphilitic disease of the brain, bromides in large doses combined with a few drops of liq. arsenicalis may be administered. Very often this remedy fails to control the fits, and if there be definite localising evidence of a localised gumma or scar in the neighbourhood of the motor area the question of surgical treatment should be considered, especially if mercury and iodide have failed to produce any amelioration. I have already mentioned that these drugs have no influence in causing absorption of dense fibrous scar tissue in the brain, consequently the old gumma acts as an irritant in spite of specific treatment. Horsley and Risien Russell recommend operative measures in such cases. I should advise operation under the following circumstances :—

1. The signs and symptoms are present of cerebral tumour, stationary or progressive, in spite of a prolonged course of antisyphilitic treatment.

2. Even when the other general signs of cerebral tumour have disappeared (viz. the headache, vomiting, and optic neuritis), under the influence of antisyphilitic treatment, the persistence of Jacksonian epilepsy may be the indication for trephining the skull with a view to remove the source of cortical irritation. This may be a pachymeningitis (vide Case 15, p. 87) or an old gumma in the neighbourhood of the motor region or in the motor region itself ; in such case there will be an associated monoplegia or monoparesis.

I have observed that the pain of a gummatous pachymeningitis may be considerably relieved by application of ol. cinereum to the shaved scalp of the region in which there is pain and tenderness on pressure. Again, a blister to this portion of the scalp may materially assist the treatment by injections (vide Case 59, p. 467).

Prognosis of cerebral syphilis. The prognosis of cerebral and spinal syphilis depends upon many factors and may be discussed in various ways. Naturally the first question which arises is whether a well-marked Hunterian chancre—positive evidence of syphilitic affection—is more likely to be followed by serious syphilis of the central nervous system than the chancroid. Now there are two points to be considered in coming to a correct conclusion ; the first being the question whether the difference in the local sore at the point of inoculation is due to the virus in one case being more active than in the other, or whether the reaction of the individual is different. It is probable that the person with the Hunterian chancre would if untreated suffer with more serious secondary and tertiary sequelae, including disease of the nervous system, but the severity of the local manifestation leaves no doubt in the mind of the patient and practitioner that energetic mercurial treatment is called for and must be continued for several years ; in the other case of chancroid there are doubts in the mind of the patient as to its being anything serious, and he neglects altogether to attend a doctor until symptoms arise, or sometimes he may be unfortunate enough to seek advice from a medical man who still thinks there is only one form of syphilitic sore, the hard chancre, and he gives only local treatment to what he is pleased to call a soft sore. This accounts in a measure, no doubt, for the fact that severe syphilitic disease of the nervous system occurs as frequently in mild primary and secondary affections as in the severe forms ; but it does not in my experience account for all the cases ; especially I have noticed that spinal meningo-myelitis has occurred in not a few cases which appeared to have been treated systematically with mercury.

I have already referred to extra-genital chancres, and I agree with Oppenheim that there is no adequate reason for supposing that these cases are more likely to lead to disease of the nervous system than infection in the usual manner.

According to my experience there can be no question of the beneficial influence of early treatment, and all writers are agreed upon this point. Fournier, Lang, Oppenheim, Hjellmann, Max Nonne, and others believe that nervous affections are more likely to occur when mercurial treatment has either been insufficient or not practised at all. A good many of the severe cases which I have seen had had no treatment prior to coming under my observation and care. The most responsive to treatment are cases of meningitis, cerebral or spinal or cerebro-spinal, provided the symptoms point to irritation rather than paralysis ; if there be associated monoplegia or hemiplegia, aphasia, apraxia, alexia, or hemianopsy, even though these conditions be transitory the prognosis is serious, for they indicate arterial disease, which is less susceptible to treatment than the meningitis. A meningitis of the base with paralysis of one or more of the cranial nerves will yield to treatment by mercury inunction or injections; if the optic chiasma and optic nerves are involved there is a danger of post-neuritic atrophy followed by partial or total blindness. Still this condition of basic gummatous meningitis is not so serious if it be taken early before the arteries are affected by endarteritis. Treatment should produce a rapid improvement of the symptoms and if at the end of a fortnight there are no signs of betterment it is improbable that much improvement can be hoped for. The cases of cerebral syphilis with mental symptoms, fits, lapses of consciousness and drowsy stupor are generally most serious; permanent improvement is infrequent and complete recovery *very* rare; the cases usually proceed from bad to worse in spite of treatment and sooner or later terminate fatally, sometimes after several remissions.

The most unfavourable are those which simulate general paralysis, for it indicates universal affection of the brain; likewise cases which indicate softening from arterial occlusion are most unfavourable; probably endarteritis is the most dangerous and the most insidious of all forms of cerebral syphilis; advanced disease may occur without producing any very definite symptoms, perhaps persistent headache only, perhaps transitory aphasia, monoplegias or hemiplegias following a faint or a fit; if such a case be treated *at once* the prognosis is much better than later, when the loss of function has become permanent, for this denotes tissue necrosis, and little good can be done towards curing a hemiplegia when contracture has occurred. Too often a favourable prognosis is given in such cases because it is of syphilitic origin, owing to a lack of understanding of the pathological process. Nervous tissue once destroyed cannot be replaced. Many cases show that brain syphilis follows a head injury. These cases generally respond well to treatment, probably the injury causes a local node or gumma.

Pure basic meningitis does not indicate a bad prognosis, neither does participation of a cranial nerve, e.g. the motor oculi, rather the reverse, for it brings a patient early under treatment. Marked choked disk may disappear and restoration of sight may be complete under treatment as many of my cases show.

Progressive neuritic atrophy generally ends in blindness. Basic meningitis is much more favourable when limited to one side; it is frequently, however, associated with arteritis; the prognosis then is bad because occlusion of arteries at the base of the brain may occur and a very small patch of softening in the pons or medulla may lead to serious paralysis and fatal complications. Acute bulbar symptoms are always serious, but when they occur in the secondary stage vigorous mercurial treatment may sometimes be followed by very satisfactory results as the following case shows.

Case 60. W. R., aged 38, commercial traveller, contracted syphilis in Japan. Six months later, while playing the piano and singing, felt faint and giddy, and, trying to drink a glass of water, found that he was unable to swallow it, the fluid regurgitating through his nose. This was followed the next day by weakness and paralysis of his left leg, left arm, and left side of the face. For a month he had to be fed with a tube. He was treated by mercurial inunction and made a good recovery, as he was able to swallow after a month and to speak. He was sent to me on his return from Japan, and he now presents the following symptoms: There is well marked late spasm of the facial muscles of the left paralysed side owing to the great affection of the lower facial muscles. The tongue protrudes slightly to the left. The left soft palate moves less freely than the right, but there is no evident paresis now of the left vocal cord. The patient is able to close both his eyes tightly and to wrinkle his forehead on both sides, but there is a marked difference between the two sides, the wrinkles on the left side being much less obvious. His speech is slow and somewhat scanning. He has considerable weakness in the legs but no wasting of the muscles. The gait is spastic and there is rigidity and slight ankle clonus, and exaggerated knee-jerks on both sides. The wrist-tap contraction can be obtained on both sides. Pupils equal and react to light and to accommodation.

Patient improved considerably under my care, and two years later he came and told me that he was able to earn his living as a billiard marker. He has no mental symptoms beyond weakness of memory.

The most successful cases which came under my care were those which pointed to a local gummatous pachymeningitis the result of a head injury. Cases in which there were no symptoms pointing to loss of function, only headache, localised pain and tenderness and cortical irritation causing Jacksonian epilepsy. In one case there were bright flashes of light and the tender spot corresponded to the angular gyrus. These cases responded rapidly to treatment with mercury.

Pseudo-bulbar symptoms are always serious, as they imply that both hemispheres are affected and they indicate a widespread arterial affection with bilateral capsular or cortical softening.

For reliable statistics in regard to prognosis we must go abroad, as London, with its enormous floating population, special and general hospitals, infirmaries and asylums, all independent of one another and with little systematic association, is a most unreliable source of information, although there is an unprecedented wealth of material.

Statistics regarding Prognosis in Cerebral Syphilis

	FOURNIER.	HJELLMANN.	NAUNYN.
Cured . . .	$\frac{1}{3}$	$\frac{1}{4}$	24 (probable)
Improved . . .	$\frac{1}{2}$	$\frac{1}{4}$	49
Death . . .	$\frac{1}{6}$	$\frac{1}{2}$	5
			10 (treatment no influence).

The above statistics, French, Scandinavian, and German, indicate, even looked at in the most favourable light, that cerebral syphilis is a most serious affection and although it is thought by many authorities that a cure may be expected in quite a number of cases, yet it is impossible to assert that the patient will not have remissions. It seems that if once the cerebro-spinal fluid is infected by the syphilitic organism, there is not the same power of attacking the virus by mercurial treatment as in other parts of the body; I have found that mercury cannot be detected in the cerebro-spinal fluid of a patient who has been for some time treated with mercury by inunction and by the mouth; this may explain why there is a tendency to a generalized infection from the base of the brain to the cauda equina. Consequently when the infective process has subsided in one situation under the influence of treatment it may arise in another situation owing to a colonization. A guarded prognosis should always be given according to my experience in all cases of syphilis of the nervous system. According to Naunyn only after five years' complete freedom from symptoms can it be asserted that a cure has been effected without any likelihood of further symptoms arising. When we have reason to suppose that the disease is a localised pachymeningitis and the symptoms disappear, we can give usually a favourable prognosis. I have seen many cases in which I had believed a cure was effected and later symptoms have developed, sometimes even in spite of continuous treatment with mercury. The examination of the cerebro-spinal fluid for lymphocytes, and the fluid and blood by Wassermann's reaction, may help very much in giving a prognosis whilst it may also afford information as to the beneficial influence of the treatment. The lymphocytes may entirely disappear from the cerebro-spinal fluid for a time under the influence of treatment and then there may be a reappearance, just as there may be a fresh eruption on the skin; it will very likely be shown that this corresponds with a fresh colonization of the organism not in a spirillar but some other modified form.

The bulk of the cases of cerebral syphilis, even when there has been systematic treatment, are only incompletely cured; the incompleteness of the cure is shown not merely by the fact that the patient is left with mental enfeeblement or some degree of paresis or paralysis, but also by the fact that after months or years quite suddenly convulsive seizures or psychical troubles may reappear (vide Cases 9–19, pp. 78–102). These recurrences are of evil omen; for as a rule specific treatment has far less influence than in former attacks.

A progressive dementia and attacks of drowsy stupor indicate extensive disease and the prognosis is always very grave.

Occasionally there may be sudden death from apoplexy due to rupture of a cerebral vessel or thrombosis of the basilar artery.

Antisyphilitic remedies have little influence upon symptomatic epilepsy when once it has become established; there is a tendency for one fit to follow another and for the *status epilepticus* to develop, leading to a fatal termination.

In spite of the serious prognosis in all cases of cerebral syphilis; yet when a patient is found to be suffering with serious organic brain disease the hope of the physician is that the disease may turn out to be syphilis and not tubercle or malignant tumours; for experience has taught him that the administration of antisyphilitic remedies in what appears to be a hopeless condition may sometimes be followed by amelioration, cure, or partial cure.

INDEX

Abiotrophy, 389.
Acute cerebro-spinal meningitis with endarteritis, case of, 113.
— polyneuritis syphilitica, 171.
— secondary syphilitic meningitis, case of, 79.
— syphilitic myelitis, 137.
  morbid anatomy of, 138.
— transverse syphilitic myelitis, 155.
  affection of sphincters in, 156.
  Brown-Séquard phenomenon in, 156.
  cases of, 157.
  course of, 158.
  macroscopic and microscopic changes in, 160.
  mode of onset of, 156.
  prodromal symptoms of, 157.
  sensory affections in, 156.
  tendon reflexes in, 156.
Alcoholic dementia, diagnosis of from general paralysis, 305.
— excess and syphilitic brain-disease, 12.
Alcoholism, diagnosis of, 305.
Alexander, on oculo-motor paralysis in cerebral syphilis, 64.
Allbutt, first description of microscopic changes in arterial syphilis by, 6.
Alzheimer on cytological examination of cerebro-spinal fluid, 202.
Amboceptor, 205.
Ambroise Paré on congenital syphilis, 416.
Amyotrophic lateral sclerosis, 164.
— — — case of in a syphilitic, 165.
— tabes, 403.
André-Thomas on the premonitory period of syphilitic paraplegia, 145.
Aneurysm, cerebral, case of, 107.
— of basilar artery, case of, 107.
Aneurysms, case of multiple syphilitic, 106.
Anosmia in cerebral syphilis, 76.
Antibody, 205.
Antigen, 205.
Anz on blood changes in syphilis, 191.
Apraxia, 95.
Argyll-Robertson pupil as sign of syphilis, 9.
— — — diagnostic value of, 15.
— — — incidence percentage of, 324.
— — — in general paralysis, 265.
— — — in parasyphilis, 250.
— — — in tabes, 323.
Armstrong, case of cranial monoplegia with crossed anaesthesia, 146.
Arterial syphilis, nodular form of, 50.
— — relation of to arterial sclerosis, 109.
— — relation of to atheroma, 49.
Arterio-sclerosis, dementia of, 304.
— diagnosis of, 303.
— relation to syphilitic arteritis, 109.
Arteritis in heredo-syphilis, 437.
— syphilitic, 44, 92.
Ashby on hydrocephalus in heredo-syphilis, 435.
Astereognosis, 95.
Astruc on syphilitic lesions of the nervous system, 5.
Asymboly, 95.
Ataxic-toxic peripheral neuritis, 176.
Atheroma, relation of to syphilis, 49.
Atoxyl in tabes and general paralysis, 288.

Babinski on Argyll-Robertson pupil, 15.
— on reflex iridoplegia, 325.
— on selective action of syphilitic virus, 246.
Bacillus paralyticans, 19.
— — brevis, 253.
— — longus, 253.
Bailey on sterility in female general paralytics, 224.
Baillarger on ‘ Dementia paralytica ’, 257.

Ballet, on case simulating amyotrophic lateral sclerosis, 164.
— on neurasthenia in prodromal stage of general paralysis, 262.
— and Paul Blocq on history of general paralysis, 257.
Barlow, case of gummata in heredo-syphilis, 437.
— and Bury on congenital syphilis, 416.
— — on early convulsions in heredo-syphilis, 444.
— — on hemiplegia in heredo-syphilis, 446.
Basic meningitis, 56.
— case of, 57.
— coma in, 61.
— convulsive attacks in, 63.
— dementia in, 61.
— diabetes in, 63.
— eye-symptoms in, 64.
— fatal case of stupor and mercurial stomatitis in, 62.
— headache in, 57.
— polydipsia and polyuria in, 63.
— psychical disturbances in, 60.
— remittent mental disorder in, 62.
— semi-coma in, 60.
— temperature in, 60.
— vertigo, reeling and staggering in, 58.
— vomiting in, 59.
Basilar artery, symptoms of occlusion of, 98.
Bayle on general paralysis, 257.
Beard on toxic action of syphilis, 432.
Beevor on case of paralysis from syphilitic meningitis, 142.
— case of pseudo-bulbar paralysis from syphilitic arteritis, 97.
Benda on spirochaetes in arterial wall in cerebral syphilis, 47.
Benedikt on optic tabes, 327.
Berger and Rosenberg on coincidence of tabes and aortic insufficiency, 379.
Bertarelli on inoculation of rabbit with syphilis, 20.
Biernacki, ulnar sensation of, 349.
Binswanger on epilepsy in heredo-syphilis, 442.
Blaschko on sex-incidence of syphilis and general paralysis, 220.
Blood changes in syphilis, 191.
— favourable influence of mercurial treatment on, 192.
Blumenthal on increase of lecithin in faeces in general paralysis and tabes, 27.
Boidin and Weil, case showing incubation of syphilis, 23.
— — on affection of central nervous system in secondary period, with case, 118.
Bordet on serum diagnosis of syphilis, 205.
Boulloche on frequency of spinal syphilis, 119.
— on onset of spinal syphilis in relation to date of infection, 119.
Bourdon and Luis, microscopical investigation in tabes, 322.
Brain syphilis, *see* cerebral syphilis.
Bramwell, Byrom, case of tabes with early gastric crises, 356.
— on antisyphilitic remedies in tabes, 386.
— on occurrence of general paralysis in tabetics, 221.
— on sex incidence in tabes, 225.
Broadbent on severe symptoms following mild syphilis, 10.
Brosius, case of multiple infection from the same source, 247.
Brown-Séquard phenomenon, 130.
— — in acute transverse syphilitic myelitis, 156.
— — in meningo-myelitis, 146.
Buschke and Fischer on spirochaete in congenital syphilis, 21.
Buzzard on proportion of cases of spinal paralysis due to syphilis, 121.

Campbell, William, on mercurial preparations for injection, 468.
Candler on bacteriological examination of cerebro-spinal fluid, 203.
— on bacteriology of general paralysis and tabes, 19.
— and Smith on Wassermann test, 208.
Castellani on *Spirochaete pallidula*, 27.
Cerebral gumma and gummatous pachymeningitis, case of, 36.
— syphilis,
  affection of eighth nerve in, 77.
  affection of fifth nerve in, 73.
  affection of hypoglossal nerve in, 77.

Cerebral syphilis, affection of seventh nerve in, 76.
    affection of sixth nerve in, 73.
    affection of third nerve in, 66.
    affection of vagus, 77.
    affection of veins, 135.
— syphilis and alcoholic excess, 12.
— — and inherited neuropathic tendency, 12.
— — anosmia in, 76.
— — cases of, 78.
— — cases of illustrating polymorphic character of, 99.
— — cases of in two brothers, 12.
— — date of onset after infection, 13.
— — encephalitis in, 50.
— — eye-symptoms in, 64.
— — hemianopsy in, 65.
— — hydrocephalus in, 50.
— — lead poisoning in, 12.
— — oculo-motor paralysis in, 66.
— — ophthalmoscopic changes in, 64.
— — optic neuritis descendens in, 66.
— — paralysis of fourth nerve in, 73.
— — paralysis of third nerve in, 66.
— — pathological anatomy of, 38.
— — pseudo-bulbar paralysis in, 50.
— — resemblance of lesions to those of general paralysis and sleeping sickness, 33.
— — stress and worry in, 12.
— — symptomatology of, 55.
— — trauma in, 11.
— — ultimate results of, 14.
— — warning symptoms in, 14.
Cerebral tumour, case of, resembling general paralysis, 313.
— — diagnosis of, 313.
— — diagnosis of from general paralysis, 313.
— — localisation of, 85.
Cerebro-spinal and basic syphilitic meningitis :—
  — diagnosis of headache in, 300.
  — — affections of cranial nerve in, 301.
  — — normal temperature in, 301.
  — — stupor in, 301.
Cerebro-spinal fluid, Alzheimer's method of examination of, 202.
— — and Wassermann reaction in general paralysis, 208; in tabes, 208.
Cerebro-spinal fluid, chemical examination of, 203.
— — in syphilis of nervous system, 200.
— — lymphocytosis in, 202.
— — micro-organisms in, 203.
— — microscopic examination of, 201.
— — physiology of, 200.
Cerebro-spinal meningitis, 110.
— — case of, 81.
— — symptoms of, 112.
Cerebro-spinal syphilis and Wassermann reaction, 208.
— — case of, 111.
— — diagnosis of, 293.
    from arterio-sclerosis, 303.
    from chronic alcoholism, 305.
    from dementia praecox, 307.
    from disseminated sclerosis, 312.
    from embolic softening, 312.
    from epilepsy with dementia, 309.
    from hysteria and hystero-epilepsy, 302.
    from Korsakow's disease, 306.
    from neurasthenia, 302.
    from tubercular meningitis, 311.
    from uraemia and lead poisoning, 311.
— — differential diagnosis from parasyphilis, 294.
— — diffuse, diagnosis of, 297.
— — diseases simulating, 294.
— — influence of early treatment upon prognosis of, 479.
— — operation in, 478.
— — prognosis of, 478.
    cases of epilepsy, 484.
    cases of local pachymeningitis, 482.
    cases of meningitis, 479.
    cases simulating general paralysis, 480.
    cases with arterial disease, 480.
    cases with bulbar symptoms, 481.
    cases with mental symptoms, 480.
    cases with pseudo-bulbar symptoms, 482.
    statistics of, 482.

Cerebro-spinal syphilis, recurrence in, 483.
— — status epilepticus in, 484.
— — sudden death in, 484.
Cestan on syphilitic polyneuritis, 171.
Charcot on migrainous attacks in general paralysis, 262.
— on tabic arthropathies, 366.
— tabes dorsale spasmodique of, 138.
— and Gombault on syphilitic myelitis, 122.
Choked disk in cerebral syphilis, 64.
Circumscribed gumma of brain, 40.
Clarke, column of, degeneration in tabes, 397.
Co-efficient causes in production of nervous lesions, 11.
Colles's law, 248, 417.
Collins, Joseph, case illustrating course of acute transverse syphilitic myelitis, 158.
— on Erb's spastic spinal paralysis, 151.
Complement, 205.
— deviation of, 207.
Congenital malformation in heredo-syphilis, 435.
— syphilitic nervous disease, *see* Heredo-syphilis.
Cornil and Ranvier on history of spinal syphilis, 121.
Corpus striatum, symptoms of lesion of, 98.
Cortical epilepsy in syphilis, 86.
Crocker on history in syphilitic skin disease, 8.
Crus cerebri, symptoms of occlusion of, 98.
Cruveilhier, early recognition of tabes by, 320.
Cytase, 205.

Debove on syphilitic peripheral neuritis, 170.
Dejerine on arrest of ataxy in optic tabes, 328.
Dementia praecox, case illustrating difficulty of diagnosis of, 308.
— — diagnosis of, from general paralysis, 307.
Deviation of complement, 206.
Diffuse cerebral syphilis, diagnosis of, 297.
— gummatous meningitis, 41.
Disseminated sclerosis, diagnosis of, 312.
— — diagnosis of, from spinal syphilis, 178.
Dittrich on syphilitic affections of liver, 6.
Dourine, 28.
— resemblance of to syphilis, 28.
Duchenne, differentiation of tabes from other paralyses by, 321.

Edinger, stress theory of, 17, 242.
Egger, vibration test of, 349.
Ehrlich on haemolysins, 251.
Eighth nerve, affection of, in cerebral syphilis, 77.
Eisenlöhr on case of pseudo-tabes with scotoma, 166.
— on pseudo-tabes syphilitica, 165.
— on spinal gumma, 129.
Encephalitis, 50.
— and heredo-syphilis, 443.
— interstitial, 258.
Endarteritis syphilitica, *see* Syphilitic Arteritis.
Epilepsy from syphilitic disease near motor area, 104.
— in heredo-syphilis, 440.
— parasyphilitic, 196.
— with dementia, diagnosis of, 309.
Erb on chronic spinal syphilis, 123.
— on four cases of general paralysis through infection by one woman, 246.
— on primary syphilitic spinal paralysis, 138.
— on relationship of syphilis to tabes, 217.
— on tabes and syphilis, 6.
Erb's spastic spinal paralysis, 150
— — — — anatomical basis of, 151.
— — — — symptoms of, 150.
— — — — syphilitic character of, 152.
— — — — two cases of, 152.
Esmarch and Jessen on syphilitic origin of general paralysis, 7.
Eudlitz, case of acquired syphilis simulating congenital, 417.
Extra-genital chancres, severity of infection from, 479.
— — special severity of nervous affections following, 12.
— infection, statistics upon, 8.

Facial nerve, affection of, in cerebral syphilis, 76.
— — transitory paralysis of, in tabes, 77.
Fagge on arterial changes in syphilitic myelitis, 122.
— on rarity of spinal gummata, 129.
Ferrier on early history of tabes, 319.
— on pathology of tabes, 400.
— on reflex pupillary arc, 408.
— on relation between syphilis and tabes, 245.
— on relation between tabes and general paralysis, 216.
Fifth nerve, affection of, in cerebral syphilis, 73.
— — case of affection of, in cerebral syphilis, 74.
Finger on increased reflexes in syphilitic exanthem, 117.
Ford Robertson, *Bacillus paralyticans* of, 19.
— on diphtheroid organism in cerebrospinal fluid, 203.
Fornet and Schereschewsky on serum diagnosis in general paralysis and tabes, 213.
Fournier as originator of theory that general paralysis is a sequel of syphilis, 7.
— classification of parasyphilitic diseases by, 187.
— on ‘analgésie syphilitique secondaire’, 117.
— on efficient treatment as preventive of nervous affections, 10.
— on epilepsy in syphilis, 196.
— on incidence of syphilis of nervous system, 189.
— on neurasthenia in syphilis, 196.
— on post-syphilitic nature of locomotor ataxy, 6.
— on relationship of tabes and general paralysis, 217.
— on syphilis as cause of tabes, 217.
— on syphilis insontium, 8.
Fourth nerve, affection of, in cerebral syphilis, 73.
Fraenkel, method of estimating muscular tonus of, 316.
Fraenkel's exercises, 385.
Fritz and Cren on the lecithin serum test for syphilis, 212.
Functional nervous affections in syphilis, 186; causation of, 191.
Fürstner on pathological changes in general paralysis, 388.

Gajkiewicz on case of onset of spinal syphilis during mercurial inunction, 121.
Gasne on affection of spinal cord in heredo-syphilis, 428.
Gautier and Maloizel, case of cerebral symptoms in secondary syphilis, 24.
General paralysis of the insane, 255.
— — — alternating with tabes in members of the same family, 231.
— — — and traumatic neurasthenia, 11.
— — — anti-syphilitic treatment in, 288.
— — — appearances of brain in, 277.
— — — asylum treatment in, 289.
— — — atheroma of aorta in, 276.
— — — average age of onset of, 236.
— — — case illustrating mental shock in, 243.
— — — case of trauma aggravating disease, 240.
— — — causes of death in, 287.
— — — constant phenomena in, 259.
— — — course of, 286.
— — — definition of, 255.
— — — diagnosis of, 314.
    constant phenomena in, 315.
    from arterio-sclerosis, 303.
    from cerebral tumour, 313.
    from chronic alcoholism, 306.
    from dementia praecox, 307.
    from diffuse cerebral syphilis, 297.
    from epilepsy with dementia, 309.
    from poly-neuritic psychosis, 306.
    from syphilitic dementia, 298.
    from uraemia, 303.
— — — discovery of, 255.
— — — discovery of disease, 259.
— — — duration of, 275, 287.
    in women, 276.

General paralysis of the insane, early anatomical investigations in, 257.
— — — emaciation in, 276.
— — — ependymal granulations in, 281.
— — — first stage of, 263.
  Argyll-Robertson pupil in, 265.
  defects of speech in, 266.
  defects of writing in, 266.
  delirium in, 271.
  delusions in, 271.
  dementia in, 272.
  hallucinations in, 271.
  intra-psychic dissociation in, 272.
  irregularity of pupils in, 265.
  loss of auto-criticism in, 273.
  loss of functions following seizures in, 270.
  medico-legal period of, 273.
  ophthalmoplegia in, 265.
  physiognomy in, 263.
  psychic automatism in, 273.
  psychic symptoms in, 270.
  reactions of pupils in, 265.
  reflexes in, 267.
  remission of mental symptoms in, 270.
  secondary infections in, 268.
  seizures in, 268.
  transitory ocular paresis in, 265.
— — — fragility of ribs in, 277.
— — — haematoma auris in, 277.
— — — history of, 255.
— — — immunity to syphilitic infection in, 189.
— — — in heredo-syphilis, 232.
— — — loss of weight of brain in, 278.
— — — lung-disease in, 276.
— — — macroscopic changes of cortex in, 280.
— — — macroscopic pathological appearances in, 276.
— — — medico-legal aspect of trauma in, 241.
— — — microscopic appearances of neuroglia in, 283.
— — — — — neurones in, 283.

General paralysis of the insane, microscopic appearances of vessels in, 282.
— — — — examination in, 282.
— — — — — methods of, 282.
— — — occasional resemblance to meningo-encephalitis, 91.
— — — optic atrophy in, 327.
— — — pachymeningitis haemorrhagica, 277.
— — — paralytic stage of, 275.
— — — pathology of, 276.
— — — prodromal period of, 259.
  aphasia in, 261.
  diagnosis in, 263.
  duration of, 259.
  epilepsy in, 262.
  eye-symptoms in, 262.
  hemiplegia in, 261.
  hyperaesthesia sexualis in, 260.
  insomnia and somnolence in, 262.
  migrainous attacks in, 262,
  neuralgias in, 262.
  neurasthenia in, 262.
  psychic symptoms in, 260.
  seizures in, 261.
  somatic disturbances in. 261.
— — — prognosis in, 287.
— — — relation of, to tabes, 216, 221.
— — — resemblance of lesions to those of sleeping-sickness and cerebral syphilis, 33.
— — — second stage of, 274.
  appetite in, 275.
  bodily condition in, 275.
  personal habits in, 275.
— — — signs of tertiary syphilis in, 276.
— — — symptomatology and course of, 259.
— — — synonyms for, 255.
— — — thickening of meninges in, 280.
— — — third stage of, 275.
— — — treatment of, 288.
  demented stage, 290.
  excitement and insomnia, 289.
  seizures, 290.
— — — wasting of brain in, 277
General pathology of syphilis of the nervous system, 20.

Gerhardt on case of syphilitic caries of cervical vertebrae, 125.
Gibson, case of repeated syphilitic infection by one woman, 246.
Gilbert and Lion on early onset of spinal syphilis, 14.
— — on onset of spinal syphilis in relation to period of infection, 119.
— — on spinal syphilis as a sequel to severe infection, 10.
Gilles de la Tourette on special neurotoxic influence in certain cases of syphilis, 12.
Goldflam, case of syphilis of meninges within three months of infection, 116.
— on onset of spinal syphilis in relation to period of infection, 119.
Goll, column of, degeneration in tabes, 397.
Gowers on acute myelitis in syphilitics, 176.
— on Argyll-Robertson pupil as sign of syphilis, 9.
— on arrest of ataxia in optic tabes, 328.
— on atrophy of auditory nerve in tabes, 374.
— on fatal case of laryngeal crisis, 357.
— on frequency of optic tabes, 326.
— on lightning pains of tabes, 331.
— on sexual excess as cause of optic atrophy, 384.
— on slight meningitis in early syphilis, 117.
— on tabes following primary optic atrophy, 329.
Graeffner on laryngeal symptoms in tabes, 356.
Greiff on affection of blood-vessels in spinal syphilis, 122.
Gumma of spinal cord, case of, 131.
Gummata in heredo-syphilis, 437.
— of spinal membranes, 128.
    focal meningitis in, 129.
    meningo-medullary symphysis in, 128.
— of meninges, 38.
    circumscribed, 40.
    diffuse, 41.
    diffuse lepto-meningitis in, 42.
    macroscopic appearances of, 38.
    microscopic appearances of, 39.
Gummata, spinal, 129.
Gummatous meningitis of roots of cauda equina, 146.
Gummatous neuritis of cranial nerves, 44.
— pachymeningitis, 41.
— tumour of cortex as cause of hallucination, 90.
— — localisation of, 98.
— tumour of brain, localisation of, 86.

Haslam on madness and melancholia, 255.
Hemianopsy in cerebral syphilis, 65.
Hereditary nervous instability in tabes and general paralysis, 239.
— predisposition to tabes and general paralysis, 238.
Heredo-syphilis, 416.
— and encephalitis, 443.
— arrest of cerebral development in, 429.
— arteritis in, 437.
— as cause of idiocy apart from gross brain lesions, 430.
— association of alcohol with as cause of nervous disease, 432.
— cases illustrating maternal immunity, 418.
— cases illustrating transmission after birth of healthy child, 420.
— congenital malformations in, 435
— deafness in, 447.
— encephalitis in, 443.
— epilepsy in, 440.
— existence of spirochaete in nervous system in, 434.
— general paralysis in, 232.
— gummata in, 437.
— hemiplegia, 446.
— hydrocephalus in, 435.
— immunity of child in, 417.
— incidence of lesions in nervous system, 428.
— infection by semen in, 418.
— juvenile tabes and general paralysis due to, 447.
— maternal immunity in, 417.
— meningitis in, 437.
— mercurial treatment of, 471.
— multiple nervous lesions in, 445.
    symptomatology of, 446.
— nervous diseases in, 416.

Heredo-syphilis, ophthalmoplegia externa in, 447.
— parasyphilitic organic diseases due to, 447.
— possibility of transmission after prolonged treatment, 423.
— post-mortem evidences of arrested development in, 433.
— prognosis of nervous diseases in, 454.
— rarity of cerebral disease in, 426.
— relation of *Spirochaete pallida* to, 425.
— speech defects in, 446.
— statistics upon causation of idiocy by, 430.
— tabes in, 231.
— tarda, cases of, 437.
— transmission to third generation, 419.
— treatment of nervous diseases in, 455.
Heubner, monograph upon syphilitic disease of cerebral arteries, 6.
— on endarteritis syphilitica, 44.
— on frequency of infection of organs in heredo-syphilis, 428.
— on pyrexia in basic meningitis, 60.
Hirschl on history in syphilis, 8.
— on syphilitic history in gummatous affections, 218.
Histaffines, 210.
History of infection in parasyphilis, 8.
Hitzig on a variety of poisons in syphilis, 16.
— on traumatic tabes, 239.
Hochsinger on birth of healthy children between syphilitic ones, 422.
— on cases of maternal immunity in heredo-syphilis, 418.
— on hydrocephalus in heredo-syphilis, 435.
Hoffmann on influence of serum on spirochaete, 192.
— on infectivity of cerebro-spinal fluid in syphilis, 24.
— on successful inoculation of syphilis from gumma, 26.
Homen, case of pachymeningitis and leptomeningitis, 128.
Homicidal paranoia in syphilis, 194.
Horsley and Risien Russell on operation in cerebral syphilis, 478.
Hughlings Jackson on nomenclature of tabes, 321.
Hunter, John, affection of internal organs in syphilis denied by, 5.
Hutchinson on Colles's law, 418.
— on deafness in heredo-syphilis, 447.
— on early acute syphilitic paraplegia, 14.
— on nervous diseases in congenital syphilis, 416.
— on onset of spinal syphilis in relation to date of infection, 119.
— on transmission of syphilis to third generation, 419.
— on use of mercury in heredo-syphilis, 456.
Hydrocephalus in heredo-syphilis, 435.
— in syphilis, 50.
Hyperaesthesia sexualis, 251, 261.
— — in general paralysis and tabes, 245.
Hypochondriasis in syphilis, 198.
Hypoglossal nerve, affection of in cerebral syphilis, 77.
Hysteria and hystero-epilepsy in syphilis, diagnosis of, 302.
— in syphilis, 198.

Ilberg, case of arrested brain development in heredo-syphilis, 429.
Immunity in parasyphilis, 249.
— in syphilis, 248.
— — — inherited, 248.
Incubation in syphilis, 22.
Inherited neuropathic tendency in brain disease, 12.
Injuries to head as causes of syphilitic brain disease, 11.
Intemperance in tabes and general paralysis, 239.
Interstitial encephalitis, 258.
Intra-cranial tumour, case of, 84.
— — cases illustrating improvement under treatment, 82.

Jarisch on increased reflexes in recent syphilis, 117.
Jasinski on syphilitic disease of vertebrae, 126.
Joffroy and Schramek on irregular pupil as sign of syphilis or parasyphilis, 9.

Jullien on nervous disease in heredo-syphilis, 427.
Junius and Arndt on heredity in general paralysis, 238.
Jürgens on affection of lymphatics in spinal syphilis, 123.
— on universal interstitial encephalitis, 50.
Juvenile general paralysis, case showing early onset of, 453.
— — — diagnosis of, 453.
— — — mental symptoms of, 450.
— — — primary optic atrophy in, 449.
— tabes, 231.
case of, 450.
diagnosis of, 453.
reported cases of, 232.

Kahler, case of multiple syphilitic neuritis of cranial nerves and spinal roots, 44.
Kernig's sign in spinal meningitis, 141.
Kjelberg on syphilis as cause of general paralysis, 7, 217.
Klausner, globulin precipitation test of, 212.
Klippel and Dainville, case of acute transverse syphilitic myelitis, 159.
Knies on frequency of third-nerve affection in oculo-motor paralyses, 72.
Koch on Erb's spinal paralysis, 152.
Koenig on heredo-syphilis as cause of nervous disease, 432.
Kohler on age incidence in epilepsy, 197.
Korsakow's disease, 306.
Krafft-Ebing, inoculation of general paralytics with syphilis by, 16.
— on immunity of paralytics from syphilis, 189.
— on prognosis in general paralysis, 287.
— on syphilitic origin of general paralysis, 7.
Kräpelin on transitory ocular paresis in general paralysis, 265.

Laignel-Lavastine and Verlin, case of gummatous meningitis of roots of cauda equina, 146.
Lallemand on syphilitic brain and nervous affections, 6.
Lambkin on syphilization in Uganda, 248.
Lambkin on treatment of syphilis, 469.
Landry's paralysis, diagnosis of, from spinal syphilis, 177.
— — simulated by syphilis, 137.
Landsteiner and Porges on Wassermann's test, 210.
— Müller and Potzl on Wassermann's test, 210.
Lang on early cerebral affections in syphilis, 24.
— on sciatica in syphilitics, 171.
— on treatment of syphilis, 469.
— on trigeminal neuralgia, 170.
Lead-poisoning and syphilitic brain-disease, 12.
— in tabes and general paralysis, 241.
Leimbach on frequency of optic tabes, 326.
Lepto-meningitis of base of brain, 42.
— — — macroscopic appearances of, 43.
— — — microscopic appearances of, 43.
Lepto-meningitis, syphilitic, 133.
Letzius on blood changes in syphilis, 191.
Levaditi on inoculation of rabbit with syphilis, 20.
— on resemblance of *Spirochaete pallida* to protozoa, 27.
— on spirochaete in congenital syphilis, 21.
— and Marie on Wassermann test, 210.
in relation to progress of general paralysis, 211.
— and Yamanouchi on incubation in syphilis, 22.
— — on serum diagnosis, 192.
— — on Wassermann's test, 210.
— Ravaut and Yamanouchi on serum diagnosis in syphilis, 211.
Lewandowsky on spirochaetes in epitrochlear gland, 22.
Leyden and Goldscheider on case of syphilitic caries of arch of atlas, 125.
Lingard on infection by *Trypanosoma Equiperdum*, 29.
Lipoid substances, 252.
Lissauer's tract, degeneration of, in tabes, 398.
Localisation of cerebral tumours, 85.
— syphilitic pachymeningitis, 86.

Locomotor ataxy, *see* Tabes dorsalis.
Long and Wiki, case with features of Erb's spastic spinal paralysis, 152.
Lumbar puncture, 201,
Lymphocytosis in herpes zoster, 202.
— in Landry's paralysis, 202.
— in pernicious anaemia, 202.
— in sleeping sickness, 202.
— in tabes and general paralysis, 202.
— in tubercular meningitis, 202.

Magnus Möller on onset of spinal syphilis in relation to date of infection, 199.
Mal de coit, 28.
Mania in syphilis, 198.
Manson on spread of trypanosome diseases, 28.
Marie on bacteriology of general paralysis and tabes, 19.
— on chemical examination of cerebro-spinal fluid, 204.
— theory of, upon pathology of tabes, 393.
— and Moquet on duration of life in tabes, 383.
Marinesco on cilio-spinal ganglion, 409.
Martin and Hiller on blood changes in syphilis, 191.
Mendel on age-incidence in epilepsy, 197.
— on conjugal tabes and general paralysis, 225.
— on hydrocephalus in heredo-syphilis, 435.
— on sex incidence of tabes, 224.
— on sterility in female tabetics, 224.
— three cases of sciatica in syphilitics, 171.
Meningitis, basic, 56.
— cerebro-spinal, 110.
and basic, 300.
— diffuse gummatous, 41.
— early onset of, in syphilis, 24.
— in heredo-syphilis, 437.
— of convexity, 81.
circumscribed, 81.
diffuse, 81.
epilepsy in, 86.
— syphilitic spinal, 141.
Meningo-encephalitis, occasional resemblance to general paralysis, 91.
Meningo-medullary symphysis, 128.
Meningo-myelitis, syphilitic, 144.
Mental stress in tabes and general paralysis, 242.
Metasyphilis, 15, 186.
Metchnikoff on action of mercury in syphilis, 35.
— on effect of mercury on syphilis immediately applied, 461.
— and Roux on communicability of syphilis to animals, 20.
Migraine in syphilis, 198.
Mild syphilis as cause of parasyphilitic affection, 10.
Minor on comparative rarity of tabes amongst Jews, 220.
Moenkemöller on conjugal tabes and general paralysis, 225.
Molenes, case of transmission of syphilis after prolonged treatment, 424.
Möller and Siemerling on venous lesions in syphilitic meningitis, 122.
Morgagni, first reference to syphilitic brain disease by, 5.
Morison, Sir Alexander, on general paralysis, 255.
Moxon on case of multiple gummata of spinal dura mater, 128.
Müller, Christian, on two cases of general paralysis in adult from heredo-syphilis, 234.
Myelitis, acute syphilitic, 137.
— acute transverse syphilitic, 160.
— punctate, 138.

Nageotte on pathology of general paralysis, 388.
— — — of tabes, 400.
Naunyn on frequency of epilepsy in cerebral syphilis, 91.
— on prognosis in cerebral spinal syphilis, 483.
Neisser and Finger on syphilitic contagium in semen, 426.
— Brück and Stern on serum diagnosis of syphilis, 212.
Nervous diseases in syphilis, evolution of knowledge of, 4.
— — in syphilitics, statistics of incidence of, 4.
— symptoms, period of onset of, 12.
Neurasthenia in syphilis, 193.
— — causation of, 193.

Neurasthenia in syphilis, diagnosis of, 195, 302.
from early tabes and general paralysis, 195.
from organic syphilitic diseases, 195.
— — homicidal mania in, 194.
— — prognosis in, 196.
— — symptoms of, 194.
— — treatment of, 196.
— with tabes, diagnosis of, 317.
Neuritic optic atrophy in cerebral syphilis, 64.
Neuritis descendens of optic nerve in cerebral syphilis, 66.
— mercurialis, treatment of, 463.
Neuroses and psychoses in syphilis, 193.
Noguchi on cerebro-spinal fluid in general paralysis, 204.
— simple method of serum diagnosis of syphilis, 213.
Nonne, Max, case of tabes in adult from heredo-syphilis, 233.
— on acute transverse syphilitic myelitis, 156.
— on birth of healthy children between syphilitic ones, 422.
— on epilepsy followed by tabes, 197.
— on parasyphilitic epilepsy, 197.
— on polio-myelitis anterior in syphilis, 162.
— on syphilitic spastic paralysis, 151.
— two cases of right-sided trigeminal neuralgia in a syphilitic, 170.

Ocular muscles, transitory paralysis of, 70.
— paralyses in tabes, 325.
Oculo-motor paralyses, complete, 72.
— — in tabes, 70.
Oedmannson on atheromatous changes in syphilitic foetuses, 49.
Ophthalmoplegia, 325.
— case of complete bilateral, 67.
Oppenheim, case of hydrocephalus commencing at puberty, 436.
— case of pachymeningitis of posterior fossae of skull, 78.
— cases of pseudo-tabes syphilitica, 165.
— on cerebral softening apart from arteritis or gumma, 49.
Oppenheim, on hemianopsy in cerebral syphilis, 65.
— on knee-jerks in spinal syphilis, 143.
— on oculo-motor affections in cerebra syphilis, 68.
— on polyuria in basic meningitis, 63.
— on severity of infection from extra-genital chancres, 479.
— on syphilitic exostoses of vertebrae, 125.
Optic atrophy in tabes, 326.
— neuritis in cerebral syphilis, 64.
— tabes, 326.
arrest of ataxy in, 328.
Orlowsky on acute transverse syphilitic myelitis, 156.
Osler on case of spinal gumma, 129.
Over-treatment with mercury as cause of nervous degeneration, 10.
— — — case of, 10.

Pachymeningitis, gummatous, 41.
— syphilitic, 128.
Paracelsus on affection of internal organs in syphilis, 5.
— on congenital syphilis, 416.
Paradoxical reaction, 324.
Paranoia in syphilis, 198.
Parasyphilis, 186.
— Argyll-Robertson pupil in, 250.
— classification of affections due to, 187.
— decay of nerve-cells in, 251.
— differential diagnosis from cerebro-spinal syphilis, 294.
— epilepsy in, 196.
— functional nervous affections in, 186
— hypochondriasis in, 198.
— hysteria in, 198.
— immunity in, 249.
— in primitive races, 235.
— mania in, 198.
— migraine in, 198.
— neurasthenia in, 193.
— neuroses and psychoses in, 193.
— paronoia in, 198.
— possible selective action of syphilitic virus in, 246.
— tabes in, 216.
— theory of its origin, 189.
— value of serum diagnosis in, 190.
Parasyphilitic affections, 15.
Parenchymatous encephalitis, 258.

Peri-endoneuritis gummosa, 169.
Peri-neuritis of optic nerve in cerebral syphilis, 66.
Peripheral nerves, affection of, 168.
— syphilitic neuritis, *see* Syphilitic neuritis.
Pernet on history of affection in syphilitic skin affections, 219.
Pierret on pathology of tabes, 322.
Piltz, experiments on pupillary movements by, 408.
Pitres on senile tabes, 237.
Plaut on Wassermann test, 208.
Poliomyelitis anterior, 162.
— — case associated with syphilis, 162.
— of syphilitic origin, 137.
Polyneuritic psychosis, 306.
— — diagnosis of, from general paralysis, 306.
Pons and medulla, symptoms of softening of, 98.
Porges and Meier on lecithin serum test for syphilis, 212.
Posterior spinal sclerosis, *see* Tabes dorsalis.
Pott's disease, diagnosis from spinal syphilis, 178.
— — in spinal syphilis, 126.
Profeta, law of, 248, 418.
Prostitutes, tabes and general paralysis amongst, 224.
Pseudo-bulbar paralysis in syphilis, 50.
Pseudo-general paralysis, 297, 306.
Pseudo-tabes syphilitica, 165.
— — case of, 167.
— — clinical indication of, 168.
— — diagnosis from tabes, 175.
Punctate myelitis, 138.
Pupil, irregularity of, as sign of syphilis, 9.
Pupillary changes in tabes, 323.

Quaternary syphilis, 15.
— — views against, 250.

Racial syphilization, 247.
— — in relation to tabes and general paralysis, 234.
Raecke on conjugal tabes and general paralysis, 225.
Ranke on brain changes in heredo-syphilis, 428.
— on spirochaetes in cerebral vessel walls, 434.
Ravaut on lymphocytosis in secondary syphilis, 117.
— and Ponselle on spirochaetes in cerebral vessel walls, 434.
Raymond on alteration of symptoms in general paralysis, 271.
Redlich and Obersteiner on pathology of tabes, 400.
Rokitanski on 'interstitial encephalitis' as cause of general paralysis, 258.
— on minute pathological anatomy of tabes, 322.
Romberg, early recognition of tabes by, 320.
Romberg's symptom, 370.
Rondoni, case of heredo-syphilis tarda, 438.
— on changes in glia in general paralysis, 283.
Roux on changes in sympathetics in tabes, 406.
Rumpf on parasyphilitic epilepsy, 197.

Saenger, case of oculo-motor paresis, 70.
Sandoz on hydrocephalus in heredo-syphilis, 435.
Savage on sexual excess in general paralysis, 244.
Schaudinn and Hoffmann on spirochaetes in syphilis, 21.
Schmaus on syphilitic arteritis and poliomyelitis, 122.
Schnabel on hyperaemia of fundus in early secondary syphilis, 117.
Schuster on interval between infection and parasyphilis, 190.
Selenew on early blood-changes in syphilis, 192.
Senile tabes, 237.
Serum diagnosis of syphilis, 204.
— — — Klausner's globulin precipitation method, 212.
— — — lecithin test of Porges and Meier, 212.
— — — simplified method of Noguchi, 213.
— — — summary of, 213.
— — — technique of, 206.
— — — theory of, 205.
Seventh nerve, affection of, in cerebral syphilis, 76.

Sherrington and Mott, experiments showing loss of muscular tonus, 363.
Sibelius, microscopic evidence of arrested brain development in heredo-syphilis, 429.
Sicard on predilection of tabes for dorsal region, 139.
Siemerling on syphilitic arteritis in boy of fourteen, 93.
Simple optic atrophy in cerebral syphilis, 64.
Sixth nerve, affections of, in cerebral syphilis, 73.
Sleeping sickness, comparison of nervous lesions with those of syphilis, 30.
— — nervous lesions in, 30.
— — relation of lesions to those of cerebral syphilis and general paralysis, 33.
Soft chancres and syphilitic infection, 9, 479.
Sottas on blood stasis in syphilitic paraplegia, 122.
— on sex incidence in spinal syphilis, 120.
Spastic spinal paralysis, 138.
— — — Erb's, 150.
— — — pathogenesis of, 138.
Spielmeyer on experimental trypanosome infection, 27.
Spiller upon affection of conus medullaris in cerebro-spinal syphilis, 147.
Spinal accessory nerve, affection of, in cerebral syphilis, 77.
— cord disease, diagnosis of, 173.
— gummata, 129.
— neurasthenia, 175.
— syphilis, 116.
— — age incidence in, 120.
— — arterial supply of cord in relation to incidence of symptoms, 139.
— — caries of vertebrae in, 125.
— — case following re-infection, 120.
— — cases of, 148.
— — causation of symptoms in, 127.
— — classification of, 123.
— — diagnosis of, 173.
    early symptoms in, 174.
    from acute myelitis, 177.
    from disseminated sclerosis, 178.
    from hysterical paraplegia, 179.
Spinal syphilis, diagnosis of,
    from Landry's paralysis, 177.
    from poliomyelitis, 177.
    from Pott's disease, 178.
    from spinal neurasthenia, 175.
    lumbar puncture in, 174.
    remission and regression of symptoms in, 174.
    Wassermann test in, 174.
— — disease of vertebrae in, 124.
— — early onset of, 13.
— — etiology of, 119.
— — exostoses of vertebrae in, 125.
— — explanation of localisation in, 139.
— — frequency of, 119.
— — general remarks upon symptoms of, 141.
— — gummata of membranes in, 128.
— — gummatous meningitis of roots of cauda equina in, 146.
— — historical survey of pathology of, 121.
— — leptomeningitis in, 133.
— — onset in relation to period of infection, 119.
— — pathological anatomy of, 126.
— — Pott's disease in, 126.
— — predisposing causes of, 121.
— — prognosis in, 179.
— — relation of morbid anatomy to clinical forms of, 123.
— — relation to nature of infection and treatment, 120.
— — relation to syphilitic eruption, 116.
— — sex incidence in, 120.
— — spinal gummata in, 129.
Spirochaete pallida, absence of, in parasyphilitic affections, 34.
— — biological position of, 26.
— — in cerebral spinal fluid, 24.
— — incidence of, in syphilis, 21.
— — in lymphatics and general circulation, 23.
— — in syphilitic meningitis, 26.
— — in tertiary lesions, 26.
— — multiplication of, 23.
— — possible differentiation of, 30.
— — possible latency and metastasis of, 30.
— — possible latency of, at seat of tertiary lesions, 30.
— — pullulation of, 23.

Spirochaete pallida, relation of, to heredo-syphilis, 425.
— *pallidula*, 27.
Spirochaete septicaemia, 427, 434.
Still on hydrocephalus in heredo-syphilis, 435.
— on rarity of coarse brain disease in heredo-syphilis, 427.
Stress and worry as causes of syphilitic brain-disease, 12.
— in tabes, 242.
— theory of Edinger, 17.
Strümpell on association of heart and arterial disease with tabes, 359.
Symptomatology of cerebral syphilis, 55.
Syphilis congenital, *see* Heredo-syphilis.
— hereditaria tarda, 439.
— insontium, 8.
— médullaire précoce, 14.
— of nervous system, and extra-genital chancre, 12.
— — — classification of diseases, 14.
— — — comparison of lesions with those of sleeping sickness, 30.
— — — general pathology of, 20.
— — — general treatment of, 473.
— — — hypotheses to account for late appearance of tertiary lesions in, 29.
— — — massage and passive movements in, 476.
— — — mercurial treatment in, 460.
— — — operation in, 478.
— — — prevention of, 458.
— — — treatment of, 458.
— — — treatment of bedsores in, 474.
— — — treatment of cystitis in, 475.
— — — treatment of insomnia and restlessness in, 477.
— of spinal cord, *see* Spinal syphilis.
— treatment of, by ingestion, 466.
— treatment of, by intra-muscular injection, 466.
— — — — — preparations for, 468.
— — — — — technique of, 468.
by intravenous injection, 471.
by inunction, 463.
by suppositories, 466.
congenital variety by mercury, 471.
cutaneous eruptions from mercury in, 462.
Syphilis, treatment of.
gastro-enteric symptoms from mercury in, 462.
mercury in, 460.
methods of administration of mercury in, 463.
neuritis mercurialis in, 463.
nutritional disturbances from mercury in, 463.
rules concerning, 459.
Syphilitic anaemia, 102.
— arteritis, 44, 92.
— — aneurysm and cerebral haemorrhage in, 105.
— — case illustrating early onset of, 92.
— — case showing recurrence of symptoms after apparent cure, 101.
— — dysarthria in, 101.
— — giddiness in, 94.
— — headache in, 93.
— — hemianopsy in, 96.
— — hemiplegia gradatim, 96.
— — macroscopic appearances in, 45.
— — microscopic appearances in, 45.
— — of basilar artery, 98.
— — of lenticulo-striate arteries, 97.
— — psychical symptoms in, 94.
— — sensory phenomena in, 96.
— — sleeplessness in, 94.
— — symptomatology of, 93.
— — theories of causation of, 45.
— — transitory paralyses in, 95.
— — triplegia in, 101.
— — varieties of, 44.
— brain disease, *see* Cerebral syphilis.
— dementia, diagnosis of, from general paralysis, 298.
— diseases of the brain, *see* Cerebral syphilis.
— — of the spinal cord, *see* Spinal syphilis.
— — of the vertebrae, 124.
origin of, 125.
varieties of, 125.
— encephalitis, 443.
— — convulsions in, 444.
— — headache and irritability in, 445.
— — symptomatology of, 444.
— endarteritis, *see* Syphilitic arteritis.
— general paralysis, 297.
— infection, difficulties of proof of, 7.
— — relation of severity to severity of nervous diseases, 9.

Syphilitic leptomeningitis, 133.
— — morbid anatomy of, 134.
— meningitis, *Spirochaete pallida* in, 26.
— meningo-myelitis, 144.
— — affection of dorsal region in, 145.
— — bladder-trouble in, 145.
— — Brown-Séquard phenomenon in, 146.
— — early meningitic symptoms in, 144.
— — girdle sensation in, 144.
— — mistaken for muscular rheumatism, 144.
— — paraplegia in, 144.
— — progressive muscular atrophies in, 146.
— — reflexes in, 145.
— — sensory dissociation in, 144.
— — sensory disturbances in, 144.
— — symptoms in, 144.
— — symptoms due to affection of cervical region, 145.
— — symptoms due to affection of lumbo-sacral region, 145.
— — trauma in, 11.
— myelitis, 122.
— — acute transverse, 155.
— neoplasms, 38.
— — effects of, on brain, 40.
— nervous diseases and over-treatment with mercury, 10.
— nervous diseases and severity of syphilitic attack, 9.
— — — history in, 8.
— neurasthenia, *see* Neurasthenia in syphilis.
— neuroses and psychoses, 187.
— pachymeningitis, 128.
— — case illustrating localisation of, 87.
— — localisation of, 86.
— peripheral neuritis, 168.
— — — diagnosis from neuritis due to malignant growths, 169.
— — — from spinal root gummata, 169.
— — — intercostal neuralgia from, 171.
— — — neuralgia from, 170.
— — — of cervical plexus, 171.
— — — of cranial nerves, 170.
— — — of lumbar and sacral plexuses, 171.
— — — of sciatic nerve, 171.
Syphilitic peripheral neuritis, primary, 169.
— — — secondary, 168.
— spinal meningitis, bladder troubles in, 143.
— — — general spinal tenderness in, 141.
— — — girdle pain in, 141.
— — — implication of nerve-roots in, 143.
— — — increase of reflexes in, 142.
— — — paraesthesia and hyperaesthesia in, 141.
— — — patches of anaesthesia and analgesia in, 142.
— — — radiating pains in, 141.
— — — regional hyperaesthesia and anaesthesia in, 143.
— — — stiffness and pains in neck and back in, 141.
— — — symptoms of, 141.
— — — vaso-motor paralyses in, 143.
Syphilomata of meninges, 38.
Syphilophobia, 194.

Tabes dorsalis, 319.
— — affection of auditory nerve in, 374.
fifth nerve in, 373.
genital organs in, 359.
glosso-pharyngeal nerve in, 374.
hypo-glossal nerve in, 375.
nails in, 375.
olfactory nerve in, 373.
skin and hair in, 375.
vago-accessorius in, 374.
— — allochiria in, 349.
— — alternating with general paralysis in members of same family, 231.
— — Argyll-Robertson pupil in, 323.
— — average age of onset of, 236.
— — bladder crises in, 352.
— — bladder troubles in, 351.
— — bronchial crises in, 358.
— — cardiac symptoms in, 379.
— — case of laryngeal crisis in, 357.
— — case with amyotrophy, 403.
— — cases showing distribution of anaesthesia and analgesia, 340.
— — cause of ataxy in, 398, 407.
— — causes of death in, 382.
— — cerebral symptoms in, 376.

Tabes dorsalis, changes in sympathetics in, 406.
— — classification of cases of, 380.
— — clitoris crises in, 359.
— — course and termination of, 381.
— — cranial nerve affections in, 373.
— — deep reflexes in, 361.
— — deficient localising power in, 348.
— — definition of, 319.
— — degenerative changes in Clarke's column in, 397.
  in endogenous systems of posterior columns, 402.
  in Goll's column, 397.
  in intra-medullary exogenous neurones in, 399.
  in intra-spinal sensory protoneurones, 396.
  in Lissauer's tract, 398.
— — delayed sensation of pain in, 348.
— — diagnosis from ataxic-toxic peripheral neuritis, 176.
  pseudo-tabes, 176.
— — diseases of bones and joints in, 364.
  pathological anatomy of, 366.
  symptoms in, 366.
— — duration of life in, 383.
— — Egger's test in, 349.
— — etiology of, 216.
— — explanation of pupillary changes in, 408.
— — eye symptoms in, 323.
— — foot-drop in, 364.
— — fractures in, 364.
— — frequency of general paralysis in, 221.
— — frequency of optic atrophy in, 221.
— — fundamental symptoms of, 323.
— — gait in, 371.
— — gastric crises in, 352.
  nature of vomiting in, 355.
  purgation with, 355.
  trunk anaesthesia with, 354.
— — general pathology of, 387.
— — girdle pains in, 332.
— — herpes in, 375.
— — history of, 319.
— — history of syphilitic theory, 217.
— — hypaesthesia and anaesthesia in, 335.
— — hypalgesia and analgesia in, 235.
Tabes dorsalis, hyperaesthesia and hyperalgesia in, 337.
— — impotence in, 359.
— — inco-ordination in, 370.
  in effect of vision upon, 370.
  of arms, 371.
— — inco-ordination of trunk muscles in, 372.
— — inequality of pupils in, 322.
— — in heredo-syphilis, 232.
— — insensibility to pressure of testicles in, 349.
— — intestinal crises in, 355.
— — juvenile, 231.
— — lancinating pains in, 331.
  herpetic eruptions with, 332.
  illusions concerning, 333.
  seat of, 332.
— — laryngeal crises in, 356.
— — local sweating in, 375.
— — locomotor disturbances in, 360.
— — macroscopic appearances of cord and nerves in, 390.
— — marriage in, 384.
— — mental symptoms in, 376.
— — microscopic examination of cord in, 391.
  of peripheral nerves in, 395.
  of posterior roots in, 392.
  of spinal ganglia in, 393.
— — morbid anatomy of, 390.
— — muscular wasting in, 372.
— — myosis in, 323.
— — objective sensory disturbances in, 335.
— — ophthalmoplegia in, 325.
— — optic, 326.
  atrophy in, 326; frequency of, 326.
— — paradoxical reaction of pupils in, 324.
— — paraesthesiae in, 334.
  illusions concerning, 334.
— — paralysis of external ocular muscles in, 325.
— — perforating ulcer of foot in, 375.
— — physiological pathology of, 406.
— — polyaesthesia in, 349.
— — prognosis in, 382.
— — pruritus ani in, 360.
— — pseudo-anginal symptoms in, 379.
— — rectal crises in, 355.

Tabes dorsalis, relationship of, to general paralysis, 216.
to syphilis, 15, 216.
— — renal crises in, 352.
— — Romberg's symptom in, 370.
— — satyriasis in, 359.
— — sense of position of joints in, 360.
— — sensory disturbances in, 329.
causation of, 330.
method of examination of, 331.
varieties of, 329.
— — sex incidence of, 224.
— — sialorrhoea in, 374.
— — sluggish pupil reaction in, 324.
— — statistics of syphilis in seventy-five cases of, 221.
— — stress in, 242.
— — subjective sensory phenomena in, 331.
— — superficial reflexes in, 340.
— — symptomatology of, 323.
— — synonyms for, 319.
— — syphilitic history in, 219.
— — thermo-anaesthesia in, 346.
— — tonus in, 363.
— — transitory facial paralysis in, 77.
— — treatment of, 383.
anti-syphilitic remedies in, 386.
Fraenkel's exercises in, 385.
of lightning pains and crises, 385.
— — trophic disturbances in, 374.
— — trunk anaesthesia in, 335.
— — ulnar sensation of Biernacki in, 349.
— — vaso-motor and trophic disturbances in, 375.
— — visceral disturbances in, 351.
Tabes dorsalis and general paralysis :
— — — antisyphilitic remedies in, 252.
— — — atoxyl treatment in, 288.
— — — conjugal, 225.
— — — effect upon fertility of males and females, 223.
— — — etiology of, 219.
— — — exposure to wet and cold in, 245.
— — — hereditary nervous instability in, 239.
— — — hereditary predisposition to, 238.
Tabes dorsalis and general paralysis:
— — — hyperaesthesia sexualis in, 245.
— — — in adults from heredo-syphilis, 233.
— — — incidence of, amongst Jews, 221.
— — — incidence of amongst prostitutes, 223.
— — — in old people, 237.
— — — intemperance in, 239.
— — — interval between infection and onset of symptoms, 235.
— — — juvenile form due to heredo-syphilis, 447.
— — — lead-poisoning in, 241.
— — — mental stress and worry in, 242.
— — — percentage of cases showing syphilitic lesions, 16.
— — — racial syphilis in uncivilized countries in relation to, 234.
— — — rarity of secondary symptoms in, 16.
— — — secondary non-specific infections in, 253.
— — — selective action of syphilis on nervous system, 246.
— — — sex incidence in, 220.
— — — sexual stress in, 244.
— — — statistics of syphilis in sixty-two cases of, 222.
— — — sterility amongst women in, 224.
— — — trauma in, 239.
Tabes tardif, 237.
Tabo-paralysis and optic atrophy, 328.
— bladder symptoms in, 352.
— cerebral symptoms in, 376.
— diagnosis of, 315.
case of cerebral softening resembling tabo-paralysis, 317.
from neurasthenia with tabes, 317.
— general pathology of, 387.
— hallucinations in, 271.
— morbid anatomy of, 390.
— lancinating pains in, 333.
Tarnowski on co-efficient factors in cerebral syphilis, 12.
Todd, ' discovery ' of tabes by, 320.
Traumatic neurasthenia and general paralysis, 11

Traumatic syphilitic meningo-myelitis, case of, 11.
— tabes, 239.
Treponema pallidum, see *Spirochaete pallida*.
Triplegia in syphilitic arteritis, 101.
Trömner, case of syphilitic polyneuritis, 172.
Trypanosoma Equiperdum, 28.
— *Evansii*, 28.
Tubercular meningitis, diagnosis of, from cerebro-spinal syphilis, 311.

Uhtoff on affection of fifth nerve in cerebral syphilis, 73.
— on affection of fourth and sixth nerves in cerebral syphilis, 73.
— on eye-symptoms in cerebral syphilis, 64.
Uraemia and lead-poisoning, diagnosis of, 311.
— diagnosis of, from general paralysis, 303.

Vagus, affection of, in cerebral syphilis, 77.
Virchow on blood changes in syphilis, 191.
— on histology of gummata, 6.
van Hutten on affection of internal organs in syphilis, 5.
von Graefe on oculo-motor paralyses in cerebral syphilis, 64.
von Halban on frequency of tabes in Abyssinia, 235.
von Leyden on pathology of tabes, 322.
— and Goldscheider on pathology of tabes, 399.
von Tiedmann and Nambu on case of pseudo-tabetic cerebro-spinal syphilis, 166.
Vulpian on pathology of tabes, 322.

Warning symptoms in cerebral syphilis, 14.
Warnock on frequency of general paralysis in Egypt, 235.
Wassermann test, 204.
— — conclusions concerning, 213.
— — history of, 204.
— — in doubtful cases of syphilis, 9.
— — new interpretation of, 210.
— — relation of, to cytological examination, 211.
Watson on pathology of juvenile general paralysis, 388.
Welander, case of acquired syphilis simulating congenital, 416.
Wernicke's pupil reaction, 65.
Westenhofer on post-mortem signs of syphilis in tabes, 234.
Westphal on relation of syphilis and tabes, 122.
Wiglesworth on optic atrophy preceding general paralysis, 327.
Wilbrand and Saenger, case of cerebral syphilis with eye-symptoms, 66.
— — case of oculo-motor paralysis, 71.
— — on central scotoma with tabetic phenomena, 166.
Williamson on a case of acute transverse syphilitic myelitis, 156.
— on frequency of spinal syphilis, 119.
— on onset of spinal syphilis in relation to period of infection, 119.
— on sex incidence in spinal syphilis, 120.
— and Gowers on a case of spinal gumma, 129.
Wimmer, two cases with symptoms of Erb's spinal paralysis, 152.

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